MAR 1 1937

Engineering News-Record

Twenty-five Cents. Five Dollars Per Year February 25, 1937 McGraw-Hill Publishing Company, Inc.

IN THIS ISSUE

Developing Added Water Supply for Los Angeles

Heated Air Space Protects Tank Walls

Progress on San Jacinto Tunnel

Retaining Wall Counterforts Support Concrete Arch Roof

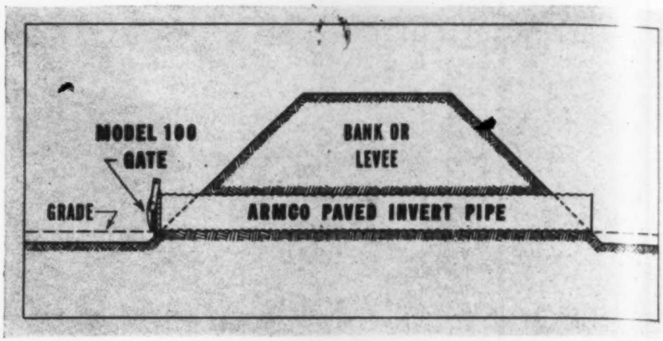
High Cost of Highway Obsolescence

Difficult Rock Blasting Job Widening Oregon Road

Extension of Sewage Disposal Recommended for Boston Area

Contractors Meet in San Antonio

Rockpicker designed to take oversize stones out of fill for All-American Canal lining


MODEL 100
GATE
BANK OR
LEVEE
GRADE
ARMCO PAVED INVERT PIPE

Floods
CANNOT BE PREVENTED
But they can be Controlled

EXPERIENCE proves two major things are essential in safeguarding property and lives during periods of high water: 1. Structures (such as conservancy dams, sea walls, or levees) that are high enough and stable enough to avert "*direct flooding*" of main areas; 2. Efficient and reliable gate structures designed to prevent "*indirect flooding*" through exposed drainage outlets—besides controlling the flow of drainage during and after flood periods.

AN EFFECTIVE INSTALLATION

Calco Gates attached to flexible corrugated metal pipe have proved highly successful in solving this latter problem. Besides being easy to install and operate, there is an economical size and model of Calco Gate for every requirement. When attached to Armco pipe, the installation forms *an integral part* of the bank or levee. High velocities, undercutting and soft, settling fills are effectively resisted.

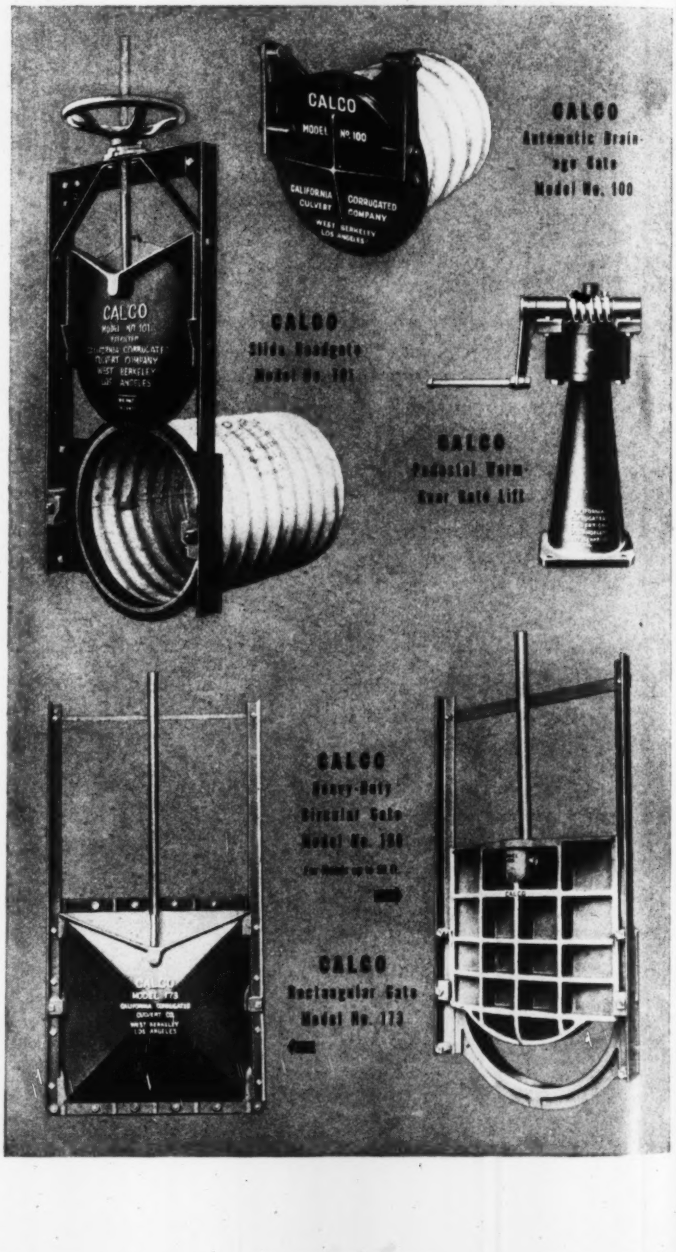
MAIL COUPON FOR HELPFUL DATA

Our long experience gained from working on hundreds of federal, municipal and private projects is available on request. Meanwhile, tell us your problem and we shall be glad to send you helpful information. Armco Culvert Mfrs. Association, Middletown, Ohio.

☐ **Send complete data on Calco Gates.**
I am interested in ______________________
(Model or use)
Name ______________________
Title ______________________
Address ______________________
ENR-2-25-37

CALCO GATES

Proved By a Quarter-Century of Experience


CALCO
MODEL No. 100
CALIFORNIA CULVERT CORRUGATED COMPANY
WEST BERKELEY LOS ANGELES
CALCO
Automatic Drainage Gate
Model No. 100
CALCO
MODEL No. 101
CALIFORNIA CORRUGATED CULVERT COMPANY
WEST BERKELEY LOS ANGELES
CALCO
Slide Headgate
Model No. 101
CALCO
Pedestal Worm-Gear Gate Lift
CALCO
Heavy-Duty
Circular Gate
Model No. 100
CALCO
MODEL 173
CALIFORNIA CORRUGATED CULVERT CO.
WEST BERKELEY LOS ANGELES
CALCO
Rectangular Gate
Model No. 173
CALCO

THE PUBLISHERS' PAGE

For Better Knowledge of CONSTRUCTION

WITHIN the last couple of weeks the newspapers have reported that an imposing committee of merchants interested in foreign trade is waging a fight for increased federal expenditure on foreign trade statistical services.

The committee finds no fault with the efficiency of the present staff of the Department of Commerce, but it points out that reductions in personnel during the depression have materially crippled its service. It asks a 25 per cent increase in the appropriation for the Division of Foreign Trade Statistics.

Naturally this page would not attempt to judge the merit of these contentions or the justification for the larger appropriation. That is beyond its knowledge and its scope. But all this is a reminder that it is time to consider the appropriation that may be made for the Construction Economics Section of the Department of Commerce. And that is very definitely a matter that should interest everyone connected with the construction industry.

UNTIL recently very little interest has been taken by the federal government in the economics of construction or in the operation and effects of the construction cycle. It took a major depression, with its all but total paralysis of construction activity, to make the American people aware of its prodigious influence upon their welfare. Eventually they came to learn how much of their employment and their business is dependent on it; eventually they saw the federal administration turn to construction as a most potent agency through which to apply federal effort toward economic recovery.

But meanwhile much debate was necessary in order that the economic significance of construction might be made clear to many influential citizens, both within and without the government. In fact, many of those engaged in the hard-pressed capital goods industries became fully aware for the first time that they were an integral part of the construction industry and dependent on its fluctuations.

During the course of that effort it became evident that there was need for more adequate statistical data and analysis of both public and private construction operations. The construction census had been initiated and was beginning to produce factual information as to the structure of the industry. Then the Construction Economics Section of the Department of Commerce was established and it seemed that we might be on our way toward real progress.

Certainly, if construction is to achieve a stability that will make it more helpful in moderating the economic cycle, it will be necessary for governmental authorities, economists, educators, publicists and industrialists generally to know more about its operations. If, as a national policy, we are to undertake a comprehensive public works program, we must have more authoritative analyses of the influences that govern construction activity. In general, a more comprehensive understanding of the construction function is of increasing importance, not only to those dependent directly upon the industry, but also to the general community. Government, manufacturing, finance, merchandising, all have a stake in its health.

UNFORTUNATELY, however, appropriations in behalf of such efforts usually are made as the result of interest on the part of those most immediately concerned. And unless the construction industry makes clear to the Appropriations Committees of the House and Senate the value of the work now being done by the Construction Economics Section, it is quite possible that in the movement for governmental economy this service may suffer. The gentlemen who are interested in foreign trade are not leaving to chance the attitude of the Appropriations Committees toward the services that mean most to them. The spokesmen of the construction industry might well profit by their example.

Willard Chevalier

ENGINEERING NEWS-RECORD Published every Thursday, Vol. 118, No. 8. Price 25c per copy. Subscription, domestic, Canada, Mexico, Central and South American countries, $5 per year. All other countries, $9 a year or 36 shillings. Entered as second-class matter October 29, 1936, at the Post Office at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Cable address "McGrawhill New York." Member A.B.P. Member A.B.C.

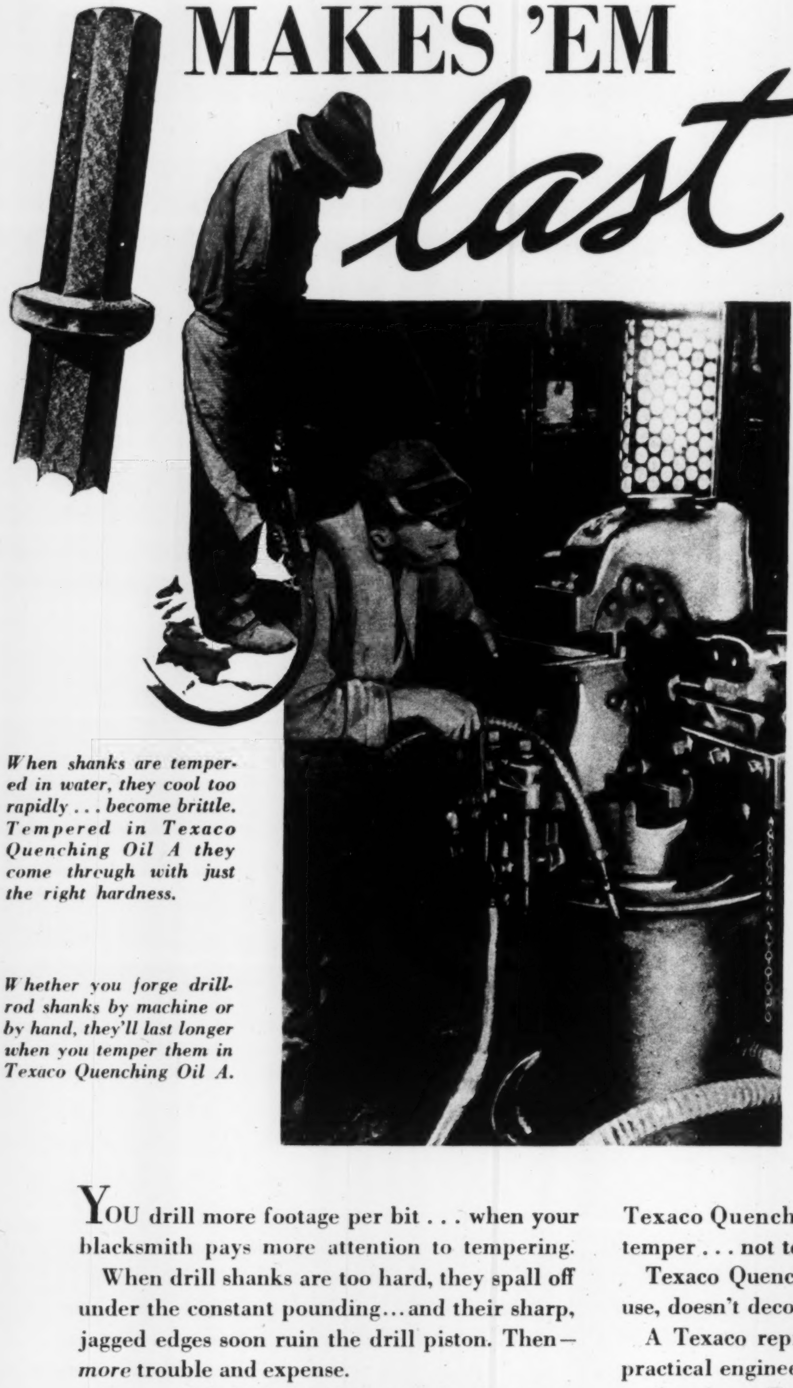
Copyright 1937 by McGRAW-HILL PUBLISHING COMPANY, INC.

Editorial and Executive Offices: 330 West 42d St., New York. Publication Office: 99-129 N. Broadway, Albany, N. Y. Branch Offices: 520 N. Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

JAMES H. McGRAW, JR., Chairman
WILLARD CHEVALIER, Vice President
MALCOLM MUIR, President
B. R. PUTNAM, Treasurer
JAMES H. McGRAW, Honorary Chairman
D. C. McGRAW, Secretary

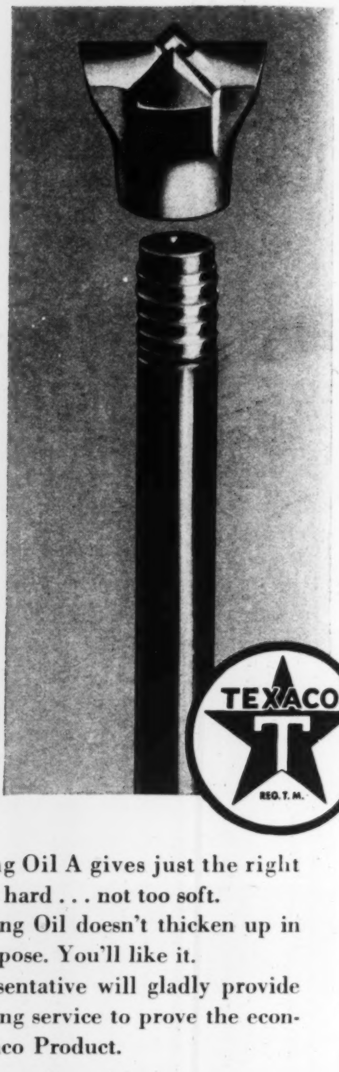
Table of Contents — See page 21

MAKES 'EM *last* LONGER



When shanks are tempered in water, they cool too rapidly . . . become brittle. Tempered in Texaco Quenching Oil A they come through with just the right hardness.

Whether you forge drill-rod shanks by machine or by hand, they'll last longer when you temper them in Texaco Quenching Oil A.



TEXACO
REG. T. M.

YOU drill more footage per bit . . . when your blacksmith pays more attention to tempering.

When drill shanks are too hard, they spall off under the constant pounding . . . and their sharp, jagged edges soon ruin the drill piston. Then—*more* trouble and expense.

To avoid drill shanks being too hard, temper them IN OIL . . . Texaco Quenching Oil A.

Likewise, temper the thread end of your drill-rods in Texaco Quenching Oil A.

Texaco Quenching Oil A gives just the right temper . . . not too hard . . . not too soft.

Texaco Quenching Oil doesn't thicken up in use, doesn't decompose. You'll like it.

A Texaco representative will gladly provide practical engineering service to prove the economies of any Texaco Product.

☆ ☆ ☆

THE TEXAS COMPANY, 135 East 42nd Street, N. Y. C.
Nation-wide distribution facilities assure prompt delivery

TEXACO

Industrial Lubricants

ENGINEERING NEWS-RECORD

McGraw-Hill Publishing Co., Inc.
Editorial and Executive Offices: 330 West 42d St., New York   Publishing Office: 99-129 No. Broadway, Albany, N. Y.

Editorial Staff
V. T. Boughton
W. G. Bowman

F. E. Schmitt, *Edior*   Willard Chevalier, *Vice-President*

Editorial Staff
C. S. Hill
H. W. Richardson
E. J. Cleary

Chicago
W. W. DeBerard

Volume 118   Number 8   Copyright 1937

San Francisco
N. A. Bowers

February 25, 1937

Developing a New Water Supply for Los Angeles 285
Wall Counterforts Support Concrete Arch Roof 291
Extension of Sewage Disposal System for Boston 292
The Rock Picker 293
Air Space Eliminates Frost Destruction in Tank Walls 294
L. A. Marshall and H. M. Whitmore
Motor Car for Inspecting Inside of 36-in. Water Main 296
Howard Wait
Greenhouse Built to Resist Hailstones 298
Filter Sand Permeability Studies *F. T. Mavis and E. F. Wilsey* 299
Difficult Rock Blasting Job Widens Road *E. A. Collier* 301
Progress in San Jacinto Tunnel 302
One Hundred Million for Obsolescence...... *Albert J. Bedard* 304
A.G.C. Meeting Report 306
Piling Casting Method Saves Forms and Storage Space 307

Book Reviews 308
Editorials 310
Current News 312
New Equipment 319

■

Mississippi Highways— Mississippi has launched a highway building program that would be a credit to one of the large industrial states. The program, together with its unusual design requirements will be described in the March 4 issue.

"CONCRETE MARKERS WILL SAVE US MONEY-

Installation of precast Atlas White traffic markers in Patterson Boulevard, Dayton, Ohio, was under the direct supervision of Rollin C. Gaylord, Maintenance Engineer of Division of Streets

... In 3 Years' Time the Cost of Painted Lines Will Equal Cost of White Cement Markers"

—H. P. ULLMER, *Superintendent of Streets, City of Dayton, Dayton, Ohio*

SUPERINTENDENT ULLMER, commenting on the installation of precast Atlas White concrete traffic markers in Dayton, says—

"It is our estimate that in three years' time the cost of painted lines will equal the cost of White Cement markers *and from there on a great saving will be made by the use of concrete markers.*"

This estimate is based on a very careful analysis and comparison of costs made by the City of Dayton.

Atlas White markers save money because they are *permanent*. You install them, and forget them. No maintenance cost. No endless painting of traffic lines. No fading. Atlas White markers *stay* white as long as the pavement lasts—clean-cut, sharply defined, easy to see.

They may be installed in old or new pavements of any type. And even coldest weather doesn't hold up the work. Precast sections, made indoors, are simply moved to the job and set in place. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South LaSalle Street, Chicago.

Help Build Safety into Streets and Highways with Atlas White Traffic Markers Made with Atlas White Portland Cement—Plain and Waterproofed

M-11

ATLAS WHITE PORTLAND CEMENT FOR TRAFFIC MARKERS

ENGINEERING NEWS-RECORD
February 25, 1937

FIG. 1—DOG SLEDS brought in the mail during the early construction stages on the Mono Basin project.

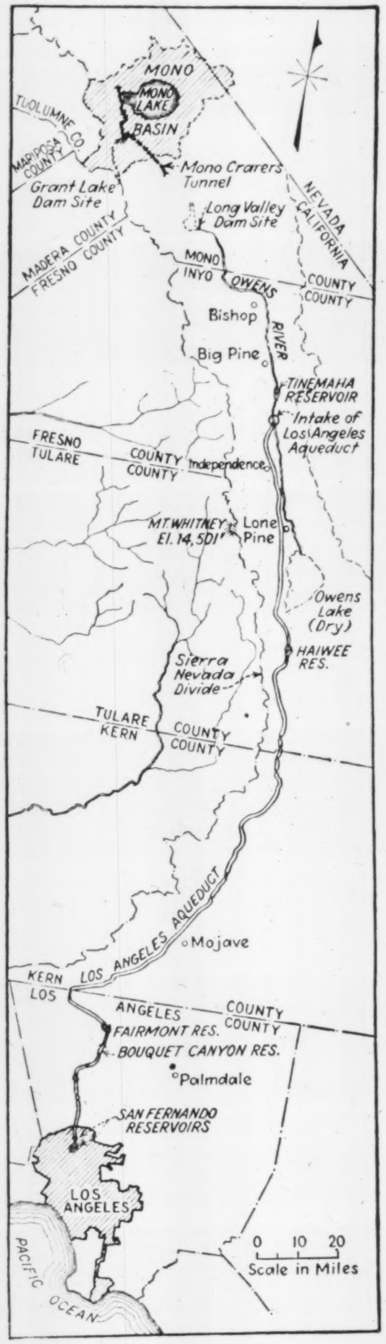
Developing a New Water Supply for Los Angeles

New high-altitude source 345 miles north of the city—Conduits, two dams and 11.3-mile tunnel included in $13,000,000 project supplementing Owens Valley source —Shaft and tunnel difficulties include water, quicksand and carbon dioxide gas

MORE WATER and more power mean so much to the Los Angeles metropolitan area that despite prospect of additional supplies of both from other sources, in recent years funds have been made available for further development of the Owens Valley aqueduct. Planned and built under the direction of the late William Mulholland at a cost of about $24,000,000, work on this aqueduct was begun in September, 1907, and the first water was delivered to Los Angeles in November, 1913. Some 250 miles of canals, conduits, tunnels and steel siphons are included in the aqueduct whose original design provided for a capacity of 436 sec.-ft.; in recent years this has been increased, chiefly by improved flow coefficients, so that as much as 505 sec.-ft. has been delivered. An important part of the function performed by this conduit has been the development of electrical energy at power drops in which a total head of 2,348 ft. has been utilized and from which the annual power output is about 266 million kw.-hr.

In dry years, as the quantity of water from Owens Valley sources has fallen behind the needs of a rapidly growing community, plans were studied and negotiations were begun looking to developing additional sources in the next watershed beyond, about 100 miles farther north. This next basin, tributary to the salty Mono Lake, includes a snow catchment area at high elevation from which the runoff will add to the city sources a dependable, continuous flow of 150 sec.-ft. The advantage of acquiring water rights in the Mono Basin included not only the water itself but also the additional power that would be created by more water through existing plants in the lower portion of Owens Valley aqueduct as well as in future plants that will utilize the 2,000 ft. of additional head in dropping from the Mono Basin level into Owens Valley. There were two major obstacles to be overcome before Mono water could be utilized in this way: (1) acquisition of existing water rights and (2) the construction of a tunnel about 11 miles long through the ridge separating the two watersheds. A report on early stages of the project was published in *Engineering News-Record*, July 11, 1935, p. 47.

Negotiations looking to bringing in Mono water began more than a decade ago but actual work on the project did not start until the fall of 1934. Because of the variety of operations to be carried out it was necessary to plan a construction program so the several elements would be completed at the same time. Because construction on the long tunnel was the limiting factor it was begun first; the time for completion of all parts of the project was set for late in 1938. Work now is under way on two earthfill dams and the major construction item, the 11.3-


MONO
MONO LAKE
BASIN
TUOLUMNE CO
MARIPOSA COUNTY
Grant Lake Dam Site
Mono Craters Tunnel
Long Valley Dam Site
NEVADA
CALIFORNIA
MADERA COUNTY
FRESNO COUNTY
MONO
INYO
OWENS
COUNTY
COUNTY
Bishop
RIVER
Big Pine
TINEMAHA RESERVOIR
Intake of Los Angeles Aqueduct
FRESNO
TULARE
COUNTY
COUNTY
Independence
MT. WHITNEY El. 14,501'
Lone Pine
Owens Lake (Dry)
HAIWEE RES.
Sierra Nevada Divide
TULARE
KERN
COUNTY
COUNTY
LOS ANGELES AQUEDUCT
Mojave
KERN
LOS
ANGELES
COUNTY
COUNTY
FAIRMONT RES.
BOUQUET CANYON RES.
Palmdale
SAN FERNANDO RESERVOIRS
LOS ANGELES
PACIFIC OCEAN
0 10 20
Scale in Miles

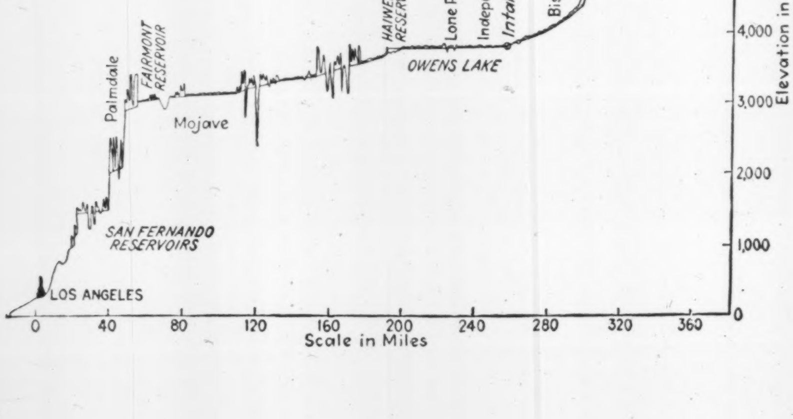
mile Mono Craters tunnel. Ultimately the development will require some additional diversion dams and conduits to bring in the flow from some of the tributary streams not included in present construction. To save interest, bonds to supply funds for this work will not be sold until the money is needed.

The runoff in the Mono Basin comes from high altitudes on the east side of the Sierra Nevada. It is notable that snow falling on the summit of Mt. Lyell (El. 13,090) will find its way down the east slope into Rush Creek and thence through the Mono Craters tunnel to Los Angeles. From the opposite side of the peak the flow is into the south fork of the Tuolumne River and via Hetch Hetchy reservoir to the city of San Francisco. In other words, Los Angeles now is developing a water source north of the latitude of San Francisco.

Force account work

A feature of the Mono Basin project is the fact that the work is done entirely by city forces and none of the major operations have been contracted. Explanation of this lies in the fact that key men in the organization which built the Owens Valley aqueduct have been retained by the Bureau of Water Works & Supply. Much of the equipment needed for the present construction has been used for maintenance or repair of the long Owens Valley aqueduct and, most important of all, the construction of the long tunnel under a cluster of extinct volcanos involved great uncertainty as to rock formation and operating conditions. The remote location with camps at elevations above 7,000 ft., nearby Owens Valley bases long maintained by the bureau and the nucleus of an organization already available combined to decide city officials to do the work on a force account basis.

FIG. 2—MAP AND PROFILE showing relation and location of the several elements of the undertaking.



Water rights and power

The waters of Mono Lake have a salt content so high that at times it approaches saturation; any runoff from the catchment area at higher levels that is to be used for potable purposes must be diverted before the tributary streams reach the lake. The salt content of the lake arises from earth formations in the volcanic region and not from content of the inflowing waters. The lake area now is about 50 sq.mi. and the depth is about 176 ft. After diversion of winter floods that now replenish it annually, the lake level will lower, of course, but it is estimated that a maximum depth of 40 to 50 ft. will remain and that the surface area will not decrease to less than 15 sq.mi. Possible ultimate uses of the lake waters lie in the recovery of soda ash and potash by processes similar to those used commercially in the dry bed of Owens Lake farther south.

Flowing into Mono Lake are Mill, Leevining, Walker, Parker and Rush creeks which bring down melted snow from high altitudes. Water rights in these streams were controlled, in large part, by the Southern Sierras Power Co. which has hydro-electric plants on Rush and Leevining creeks. At one time the company had a project for conveying this water to Riverside some 450 miles distant where the company supplied electrical service and where there is good market for mountain water. A subsidiary of the Southern Sierras Power Co., the Cane Irrigation Co., was immediate owner of the rights ultimately purchased by the city of Los Angeles. The remaining private water rights were secured principally by condemnation.

Owners of littoral land around Mono Lake protested the Los Angeles plan for using Mono Basin Water because this would cause lowering of the lake level. After a jury trial, damages to these land owners were paid by the city. Thus the city obtained rights to all water flowing in the streams from the high catchment basins to the west. The development program contemplates diversion of these streams into Grant Lake reservoir whence gravity flow will deliver it to the upper end of the long tunnel.

The profile in Fig. 2 shows why power can be developed from Mono Basin water as it passes down the steep Owens Valley gorge. It is estimated that a total of 100,000 hp. can be gen-

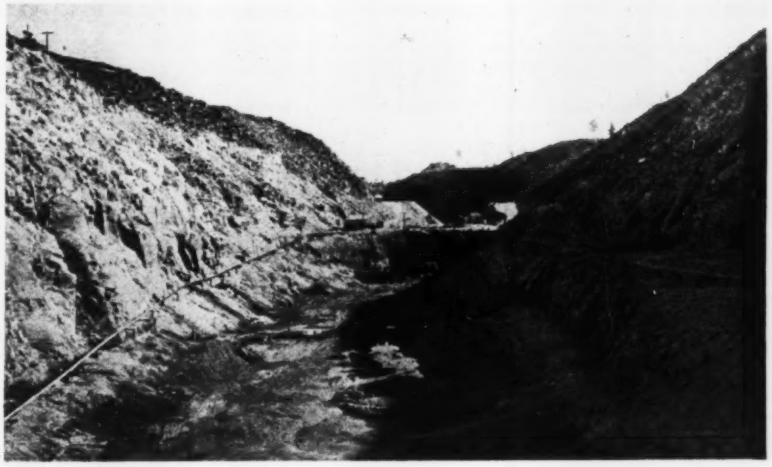
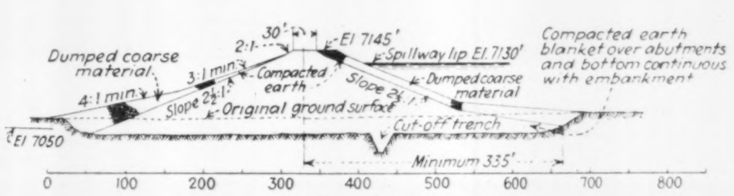
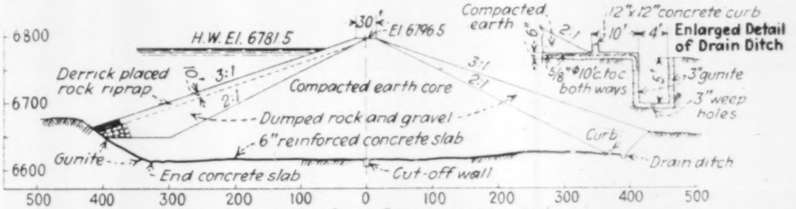


FIG. 3—LONG VALLEY DAM SITE looking downstream. Note 50-ft. depth of overburden. Buildings in background are at streambed level.



30'
2:1
El 7145'
Spillway lip El. 7130'
Compacted earth blanket over abutments and bottom continuous with embankment
Dumped coarse material
3:1 min.
Compacted earth
Slope 2½:1
Dumped coarse material
4:1 min.
Slope 2½:1
Original ground surface
Cut-off trench
El 7050
Minimum 335'
0
100
200
300
400
500
600
700
800

Maximum Section of Grant Lake Dam



6800
H.W. El. 6781.5
30'
El 6796.5
Compacted earth
2:1
12"x12" concrete curb
10'
4'
Enlarged Detail of Drain Ditch
6700
Derrick placed rock riprap
10'
3:1
2:1
Compacted earth core
3:1
2:1
5/8" ϕ 10" c. to c. both ways
5'
3" gunite
3" weep holes
Dumped rock and gravel
6" reinforced concrete slab
Curb
6600
Gunite
End concrete slab
Cut-off wall
Drain ditch
500
400
300
200
100
0
100
200
300
400
500

Maximum Section of Long Valley Dam

FIG. 4—MAXIMUM SECTIONS of Grant Lake and Long Valley earthfill dams.

erated there, though present indications are that this will not come about until available power from Boulder Dam has been utilized.

Two earthfill dams

Grant Lake dam which will constitute a storage reservoir above the tunnel will have a spillway level at El. 7,130; the storage capacity below this level will be 48,000 acre-ft. The dam will be an earthfill structure with a maximum height of about 90 ft. and a crest length of 750 ft. The maximum cross-section showing slopes and surface treatment is reproduced in Fig. 4. The outlet tunnel from this reservoir is about 3,500 ft. long and will deliver into a 500-sec.-ft. canal (either open or closed, as later decision may decree) extending 4 miles to the west portal of the Mono Craters tunnel.

Work of stripping the site for Grant Lake dam was begun in 1935. (Open season at this elevation is from April to November.) Before cold weather made it necessary to shut down the work for the winter of 1936-37 the outlet tunnel (capacity 500 sec.-ft.) had been driven and lined and some 250,000 cu.yd. of rolled fill and rock had been placed in the main dam. As the total yardage will be 640,000, about one-third the yardage now is in place.

The spillway near the west end of the dam requires a cut about 100 ft. deep which was located with a view to using the material excavated. Material from the spillway and from a borrow pit in the reservoir is balanced to get size gradation in the main dam that will permit maximum compaction. Material for the fill is first put through a grizzly from which the fines are taken to the upstream portion of the dam and the coarse material goes to the downstream side or is stockpiled for the layer of rock that will finish off both up- and downstream slopes.

Grant Lake dam is in a glacial moraine through which stream flow has cut the present streambed. Material in the moraine is fairly tight though there are lenses of gravel and sand. The construction program is to make a tight, compact fill with slopes such that the path of percolation will be about 8:1 and to supplement this with a blanket of fines extending 100 or 150 ft. into the reservoir from either end of the dam. Material in the fill is being trucked to place, deposited in layers of roadway width, rolled, sprinkled and tamped. Diversion of Rush Creek which flows through Grant Lake dam site was accomplished by building the outlet conduit under the dam first.

Long Valley dam is being built about 17 miles downstream from the lower end of the long tunnel. At this point placement of 1,045,000-cu.yd. fill will create a dam 167 ft. high, of which 50 ft. will be below the streambed level. The crest length is 550 ft. and the base thickness 870 ft. This dam will store about 163,000 acre-ft.

When stripping was started in 1935 at the site originally selected the underlying rock was found to be creviced and a fault was uncovered. Hence the location was moved about half a mile upstream and the present work was begun in the fall of 1935. The formation at this present location is tuff entirely across the stream. The design calls for a cutoff trench on the center line of the dam in which grouting of the foundation will be done through 4-in. grout pipes put down 5 ft. apart. If it is found that considerable quantities of grout are required intermediate holes will be put in. When the foundation is uncovered a concrete mat 6 in. thick will be placed on the bottom and the walls of the canyon will be gunited to a thickness of 2 or 3 in. over the entire canyon area included within the outlines of the dam. This is to prevent water from leaking through the canyon walls into the structure which constitutes the dam itself. Diversion of stream flow was effected by a concrete-lined tunnel around the left abutment. Most of the diversion tunnel will be used as a bypass tunnel after the dam is finished.

The fill will be made with carefully graded material, sprinkled and rolled for maximum compaction and, as at Grant Lake dam, an impervious blanket will be laid on the reservoir side slopes adjoining both ends of the structure. A maximum section of this dam showing the slope treatment is reproduced in Fig. 4.

More power available

Long Valley dam will control runoff from 437 sq.mi. of the upper Owens River Basin. Although this water heretofore has been caught at lower levels for diversion into the existing aqueduct, the ability to hold flood flows at the Long Valley elevation means the addition of about 50,000 hp. to power plants that later can be built in the Owens River gorge. Mono Basin water will add another 50,000 hp. of potential power in this gorge. These develop-

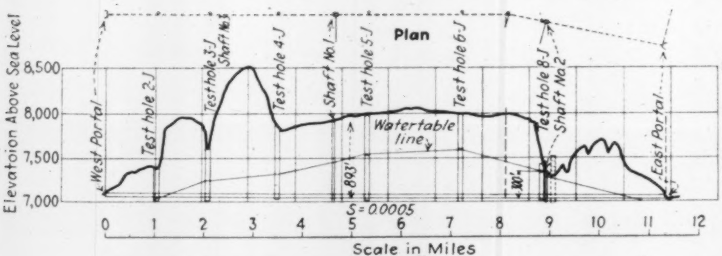


FIG. 5—MONO CRATERS TUNNEL in plan and profile.

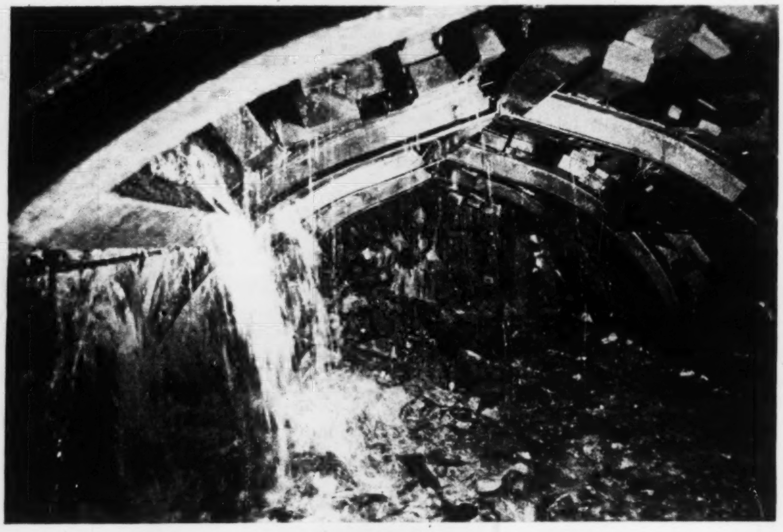


FIG. 6—THE INFLOWING WATER also brings dissolved gas which promptly escapes into the air when the water reaches atmospheric pressure in the tunnel, adding to the difficulties of tunnel construction.

ments of storage and additional water from the Mono Basin also will increase power production on the existing plants at the lower end of the aqueduct.

Mono Craters tunnel

From the start it was obvious that the tunnel would be the controlling factor in the date of completion of the project and work on this unit was begun as early as possible. As a preliminary to construction it was necessary to build roads as well as water, power and telephone lines and to establish camps suitable for habitation in the rigorous climate where temperatures are as low as 20 deg. below zero in winter. Four camps on the tunnel were established; at west portal (the upper or Mono Basin end), at shaft No. 1 (El. nearly 8,000 ft.), at shaft No. 2 and at east portal which is on the lower or Long Valley end.

Three tunnel locations were compared with the aid of core drill records before making the final selection of route. The location selected passes under some of the extinct volcanic craters and the core borings indicated that the formation is very much broken up and varies widely from tuff through more or less cemented formations of gravel to rock of varying degrees of hardness.

The original plan contemplated the use of two shafts, No. 1 and No. 2, to speed up driving operations by increasing the number of headings. A third point of access, shaft No. 3, was decided upon later for ventilation when CO_2 gas was encountered in quantities in the west portal. The tunnel section inside the concrete lining, 9 ft. high by 9 ft. 7½ in. wide, was selected as the minimum in which standard driving equipment could be operated economically. In the light of difficulties with gas and water it now is agreed that a larger section would have been more convenient and might have saved time.

Thus far much of the tunnel has been timbered; both steel and timber sets have been used with preference for the former (*ENR*, May 23, 1935, p. 745). The lining is unreinforced and has a minimum thickness of 6 in. inside the temporary timber supports. Cross-sections are shown in Fig. 8. The total length of the tunnel is 59,811 ft., of which 33,909 ft. had been driven Nov. 15. If two additional headings can be started from the bottom of shaft 1 by the early part of March this would provide four working faces. If a progress rate of 20 ft. per day could be maintained in each of four headings the remaining 25,000 ft. to be driven could be completed as per schedule in the fall of 1938.

An unlined canal paralleling the river will be built to convey water from the east portal to Long Valley dam. From the dam water will be released into the natural stream channel in which the flow will continue to the aqueduct intake.

Inflows of gas

The west portal heading in the long tunnel began to encounter carbon dioxide gas about 2 miles from the portal and near the throat of an old crater. The gas came in with inflowing water which entered the tunnel under pressure. In the atmospheric pressure of the tunnel, gas which had been dissolved in the water immediately escaped into the air. This put a heavy additional burden on the ventilating system.

When the heading reached a zone where large inflows of water were encountered (a total flow of 2,000 g.p.m. came in in a distance of about 350 ft.) so much gas escaped into the tunnel that special measures for handling it were necessary. It was at this time that shaft 3 was decided upon so fresh air could be drawn in from the outside without putting an additional ventilating pipe through a 2-mile length of already crowded tunnel. This shaft, 535 ft. deep, was put through in 31 days by sinking and raising at the same time. There are two compartments, a hoistway and a manway. Blowers were installed at the foot of the shaft to make use of the new short route to outside air.

The gas protective measure of greatest value in the short length of tunnel where the heavy inflow was encountered consisted of a corrugated iron lining or sheathing of the tunnel. The metal sheets were curved to fit the tunnel arch and also were put on the side walls so inflowing water and the gas that came with it were carried outside the arch and behind the side walls to the tunnel invert. A ditch about 2½ ft. below subgrade was excavated in this portion of the tunnel and at track level a 2-in. plank floor was put in to roof over what amounts to a "gas sump." The floor is supported on transverse 8x8-in. timbers on 3-ft. centers. Track rails are on top of the planks. As CO_2 gas is heavier than air it tends to collect in this trap beneath the floor. This tendency was increased by the use of gunite around the ends of the metal housing and an exhaust pipe with its intake in the space beneath the floor which develops a slight negative pressure in the invert compartment. Air thus exhausted is pumped out of the tunnel.

After extended operating experience,

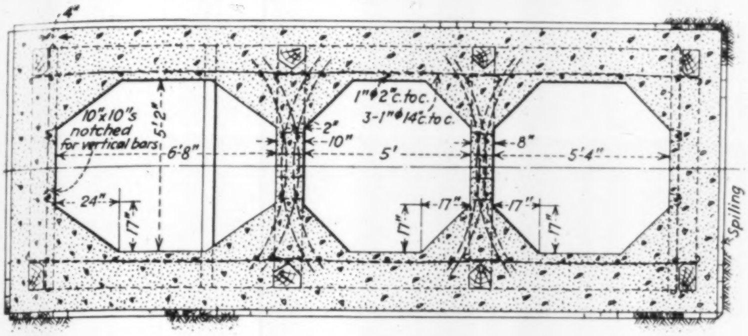


FIG. 7—**HORIZONTAL SECTION** through concreted portion of shaft No. 1.

methods of handling the gas have been developed so that it does not materially slow up operations. Grouting equipment able to develop pressure of 700 lb. per sq. in. is now on the job and where gas conditions are bad the water which brings the gas in is promptly grouted off. The expense of this grouting is not justified unless gas is present, the water itself is not a serious problem and is handled readily by the pump equipment. Test holes, using 40-ft. drills, are used to explore ahead as the face is advanced. The test holes are fanned out around the heading and sometimes three or four are put in. The result of these tests determines whether grouting will be done.

Daily tests for CO_2 gas are made at the west portal and at ten stations between the portal and the face. These tests determine by the sodium hydroxide method the quantity of gas per pound of water and per cubic foot of air. The amount of CO_2 escaping via the west portal (in both air and water) has been about 450 cu.ft. per minute. However, the system for handling this gas is such that the percentage in the air which the workmen breathe is kept constantly less than 2 per cent. The gas itself is not poisonous but as it is heavier than air, when it lodges in the lungs it keeps oxygen out and thus causes suffocation. If air contains as much as 8 per cent of CO_2 the condition is considered serious; 12 per cent is rated as a fatal quantity after a few minutes' exposure. Content of 12 per cent or more is usual in the invert compartment under the floor.

Difficulties in Shaft 1

Shaft 1 was located at the point believed most advantageous in terms of (1) providing two additional working faces in the long tunnel and (2) giving access to tunnel grade with minimum cost and difficulty of driving. This second consideration took into account both depth and rock formations. At the point selected the depth of shaft to be driven from ground surface to tunnel invert totals 893 ft. to which must be added an additional 50 ft. for sump and loading compartment. The shaft is being driven with three compartments (two for skips and the third for manway and utilities). The determining factor in selecting size of the skip shaft was a minimum that would pass a Conway 50 mucking machine.

The concrete shaft lining, as shown in Fig. 7, was not developed until after considerable experience with the difficulties involved. With this section, by reason of the fillets and the reinforcing rods in the partitions, the shaft has been able to resist extreme pressures.

Work on the shaft was started in February, 1935. The first water was struck at 490 ft.; at 540 ft. the shaft passed through rhyolite and into a cinder zone. From this point on to a depth of 763 ft., which was reached last July, progress was slow and difficult.

By putting in collecting rings and pump chambers it was possible to handle the water satisfactorily even in

FIG. 8—**TUNNEL SECTIONS** showing timber and steel sets. The latter have a crown shaped to make space for concrete lining discharge pipe.

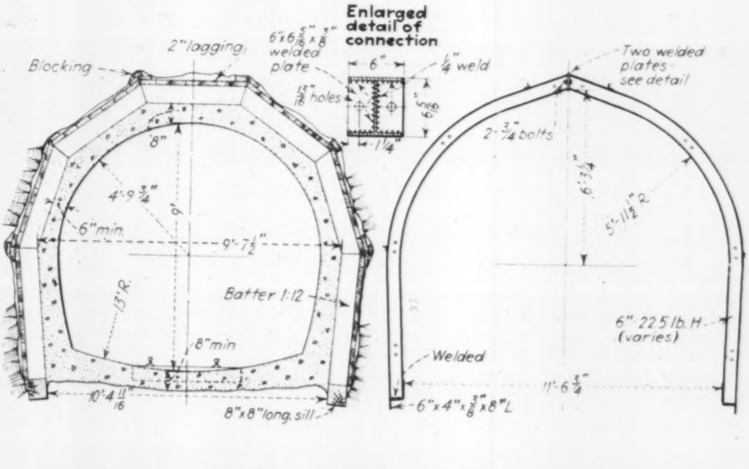
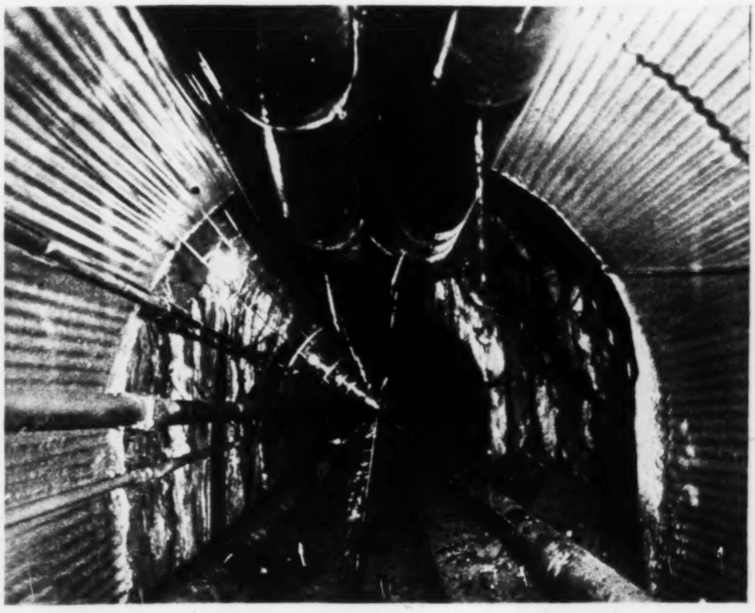


FIG. 9—**METAL HOUSING** used to convey gas-bearing water to a gas tap beneath a plank floor. The vent pipes are 18 in. in diameter.



quantities larger than those encountered (the maximum has been about 500 g.p.m.). However, with the inflows of water came "runs" of quicksand; on several occasions the lower portion of the shaft was flooded and in one "run" water level in the shaft raised to 300 ft. above the bottom. When this finally was pumped down it was found that a 145-ft. depth of very fine sand had been deposited in the shaft.

The quicksand usually came in with water under high pressure, sometimes the depth of water in the shaft increased 100 ft. in an hour. Workmen sometimes escaped by such a narrow margin as to leave their boots stuck in the quicksand. Down to the 763-ft. level a total of 1,500 cu.yd. of material in excess of the volume of the shaft itself had been removed.

Difficult timbering

Repeatedly the timbering of the shaft was forced inward by pressure. So long as the formation traversed was adequate for supporting the weight of the lining, the shaft was concreted, however there were long stretches through soft material where the timbering had to be supported from above. At one time the timber sets extended down 200 ft. below the support. Here the hooks of the steel hangers on which the weight was carried started to straighten under the load. Then lines of ¾x6-in. steel straps were passed down on the inside face of the timbering. Eighteen of these straps, anchored into concrete at the top, were carried down the face; each line was welded into a single continuous strap. A lag screw was put through the strap into the timber as each set was passed.

Near the top the timber sets were put in at 5-ft. intervals using 8x8 timbers. below the rock the centers were 4 ft. apart and 10x10-in. timbers were used; intermediate sets were used occasionally. When the spiling was driven, the voids back of it were grouted under pressures of 100 lb. per sq.in. The grouting was done by means of a perforated pipe put through a hole bored in the spiling. The pipe was either jacked or jetted in and grouting was done when the penetration was about 6 ft. This method was satisfactory in the better formations but finally a level was reached where the grout began to boil up in the bottom of the shaft, sometimes bringing in with it rocks up to 100 lb. in weight. From July to November practically no progress was made in sinking the shaft. However, during this time a 14-in. test well had been put down from the bottom of the shaft to tunnel grade. This proved that the tunnel itself was in sandstone. The test well had a 16-in. perforated casing for the first 60 ft. and from this point on down the casing was 5 in. in diameter. The fact that the hole remained opened, indicating little tendency to run, gave encouragement to continuing sinking the shaft with the aid of higher pressure grouting.

At several levels drifts were put out in both directions from the shaft and were carried around the timbering. Bulkheads were put in and were concreted up to prevent runs. In some cases as much as 200 cu. yd. of gravel was taken into the drifts and used to refill pockets that had been caused by runs.

Sinking operations in shaft 1 are continuing with the use of steel sheetpiling 7 ft. long in place of the timber spiles formerly used. Also a grout pump that could use pressures up to 250 lb. per sq. in. has been provided. With this equipment as much as 60 sacks of cement have been put in in one round using an 8-ft. length of perforated grout pipe. Since the adoption of the steel sheetpiling and higher pressure grouting progress has improved and it is expected that the shaft can be completed by the end of February, 1937.

In the light of experience with this shaft, those in charge have agreed that a design better adapted to these conditions would have been a circular shaft put down with the aid of a shoe that could be jacked ahead, permitting the concreting in of the lining as the shoe advanced.

Shaft No. 2, whose location was determined by topography at a point 12,735 ft. in from the east portal, has a depth from ground surface to tunnel grade of 300 ft. The shaft was continued below invert level some 50 ft. to provide for muck pockets and sump. It went down at an average of 6 ft. per day. Progress was facilitated by a 16-in. well driven alongside 10 or 12 ft. away and cased with perforated pipe so it would serve to drain the shaft by operation of a deep well pump. (*ENR*, July 4, 1935; p. 13).

The tunnel from east portal to shaft 2 was holed through in July, 1936, and lining operations now are under way. On Nov. 15 the heading being driven to the west from shaft 2 had advanced some 6,000 ft. and was in a cemented gravel formation with inflowing water about 4,500 g.p.m.

Cost estimates increased

The initial major expenditure on the project was about $5,000,000 for water rights and other Mono Basin purchases. Original construction estimates placed construction costs, exclusive of water rights, at $10,000,000. Recently this estimate was increased to a total of $13,000,000 mainly as the result of (1) increased cost of driving the tunnel by reason of gas and water inflows, (2) expensive work in sinking shaft 1 and (3) relocation of Long Valley dams with resultant cost increases incidental to building a rolled earthfill as compared to the rockfill originally planned. Out of the total of $13,000,000 for construction costs about $8,350,000 had been spent by the end of 1936. The over-all cost of driving and lining the tunnel is estimated to be $100 per linear foot.

The work is being done by the Los Angeles Bureau of Water Works & Supply, H. A. VanNorman, chief engineer and general manager. Mr. VanNorman was on construction of the Owens Valley aqueduct as assistant to the late William Mulholland whom he succeeded as head of the department. H. L. Jacques is superintendent of construction on the Mono Basin project and R. R. Proctor is field engineer. The field organization includes the following men in charge of the several divisions: E. A. Bayley, in charge of surveys; William Cahill, general foreman, Grant Lake dam; Robert G. Martin, general foreman, west portal, Mono Craters tunnel; Jack Caulfield, general foreman, shaft 1; Stanley Donham, general foreman, east portal, Mono Craters tunnel; and Sidney L. Parratt, general foreman, Long Valley dam.

◆

Detroit Housing Projects Ordered Redesigned

Because all bids which have been received for construction of the superstructures of the Brewster and Parkside PWA housing projects in Detroit have exceeded the estimates and have been rejected by PWA, Administrator Ickes has authorized the alteration of design and construction specifications on these projects in an effort to lower the cost.

The revised plan, as proposed, would not alter the number of living units to be provided by either project but would employ construction methods which should result in economies over previously proposed plans. Foundation work on the two projects, which involve PWA allotments totaling $10,000,000, is complete, and the revised scheme calls for erection of structures on the existing foundations. Brick veneer construction is to be used on the group houses and flats in both projects instead of the previously proposed solid brick and concrete construction, while apartment buildings will remain substantially unchanged. A change from a single central heating plant to group heating for the various units is also under consideration for the Parkside project.

The Brewster project covers 28 acres and will house 699 families. The Parkside project houses 779 families on its 30 acres in buildings which cover less than 20 per cent of the project area.

It is hoped that the architects will be able to develop the new plan in time for construction contracts to be let for June 30.

Retaining Wall Counterforts Support Concrete Arch Roof

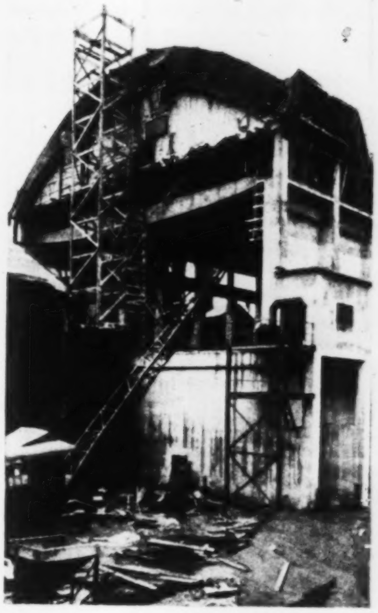
Unusual concrete building housing rock storage at a cement plant built during cold weather with high-early-strength cement

BY COMBINING retaining walls and a thin tied-arch concrete roof, an efficient storage building for rock used in cement manufacture has been developed by the Lone Star Cement Corp. at its Nazareth, Pa. plant. Counterforts used in the side walls on 16 ft. centers are extended above the walls to provide support for the roof and for crane girders. The rear wall, of cantilever type, is built full height which is 76 ft. from the top of the footings to the crown of the arch roof. A belt conveyor tunnel forms an integral part of the base of this wall. A belt conveyor gallery is also incorporated in one of the side walls. The front wall of the building is a cantilever wall 25 ft. high.

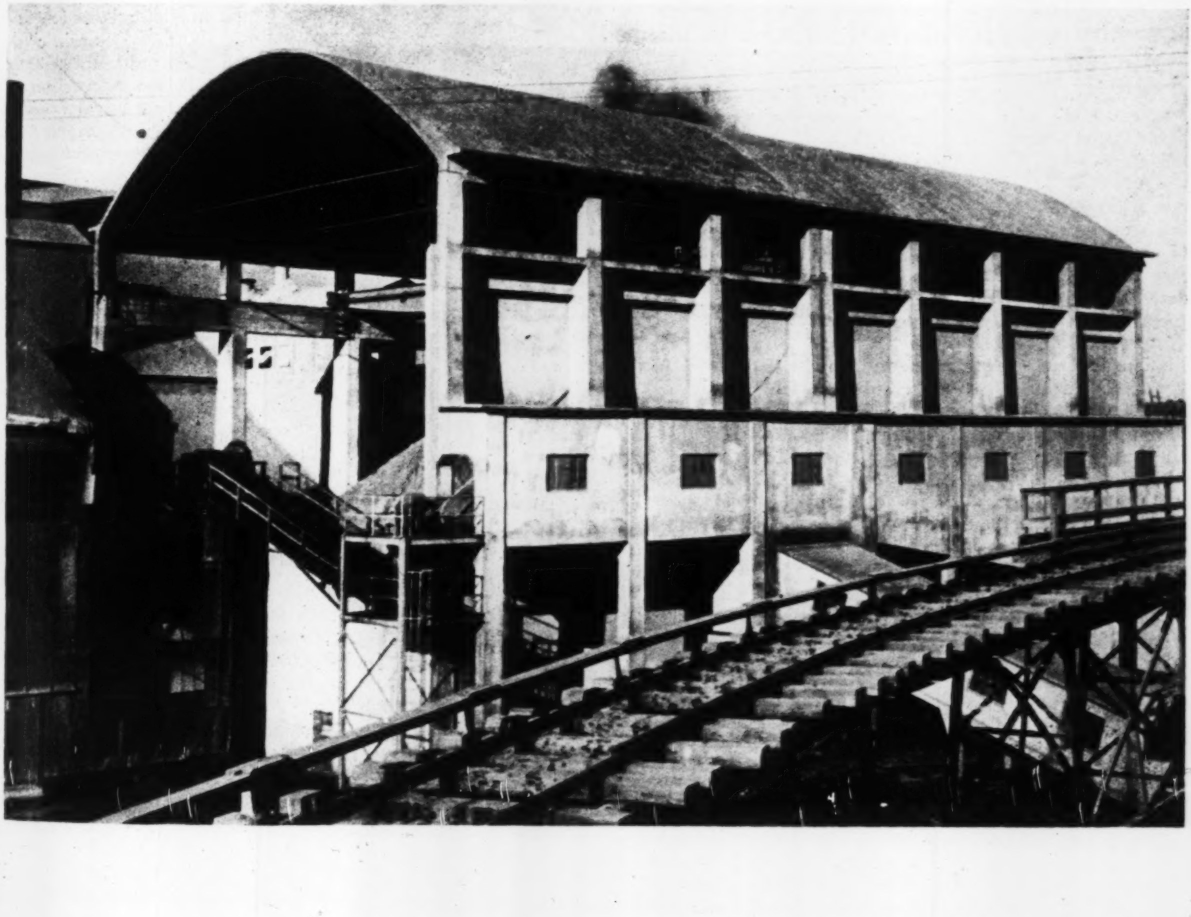
In addition to its special design features, the building was built during cold weather, using sliding forms on inclined as well as vertical wall surfaces. The use of high early strength cement for all of the structure except the back wall speeded the work, since forms were removed from the columns 4 hr. after concrete was placed and from the girders and beams after 24 hours. The roof concreting was protected by tarpaulins and salamanders.

Roof is 6 in. thick at crown

The storage building is 75 ft. wide, 114 ft. long and 76 ft. high to the crown of the roof. An expansion joint divides the structure into two sections 49 and 65 ft. long. Storage space is formed by the side and end retaining walls. The reinforced-concrete parabolic arch roof has a 79-ft. span and a 16-ft. rise. It is 6 in. thick at the crown and 12 in. at the springing line. The eaves, designed as horizontal girders to take the arch thrust, are supported by 20x24-in. columns which are extensions of the retaining wall counterforts. At the column supports the girders are tied across the building by two $2\frac{1}{4}$ in. steel rods. The roof is supported on a sliding bearing at one side and on fixed bearings at the other.



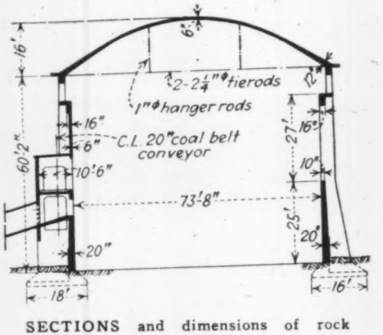
CONCRETING the arch roof in forms supported from the crane girder which was moved along as concreting advanced.



ROCK STORAGE BUILDING roofed with a parabolic concrete arch supported on extensions of the wall counterforts.

Since the steel girders of the traveling crane were placed as soon as the crane beams were completed, these were available as supports for the roof forms. In addition a timber shoring tower was constructed under the crane girders at the center. This tower, mounted on rollers, was moved with the crane girder as roof concreting progressed. The form segments, previously cut and framed on the ground, were designed for placing the roof in seven sections. A working platform built up to the elevation of the eaves beams was also designed to be moved as each section was concreted. Since it fouled the steel tie rods across the building this movable framework was made in three parts designed so that hardwood wedges could be used to raise and lower the frame to required position.

Extra care was exercised in placing the $\frac{3}{8}$-in. steel rod reinforcing in the roof slab. Specially designed chairs were used to hold the steel in proper position and the steel screed rods were supported in the same manner. These rods were run lengthwise, 6 ft. on centers, to guide a straight edge used to level off the concrete to the curvature of the roof.



SECTIONS and dimensions of rock storage building.

Form stripping times were determined by control cylinders poured with each roof section. In every instance it was possible to move the forms forward for the next section within two days after pouring.

In pouring the roof a shallow layer of 4-in. slump concrete was deposited first so that the bottom reinforcing would be fully embedded and underside honeycombing eliminated. This first layer was followed by stiffer concrete of $1\frac{1}{2}$ to $2\frac{1}{2}$ in. slump. Concreting was done simultaneously from the eaves on both sides toward the center of the roof. At the steep part of the roof, concrete with a 1" slump was employed.

The building was designed by the Lone Star Cement Company's engineering department and was built by M. A. Long Co., under the supervision of E. C. Machin, general manager of the contractor's Allentown division.

Extension of Sewage Disposal Facilities Recommended For Boston Area

Report filed for legislative consideration finds harbor pollution not objectionable but increasing, and urges that improved disposal facilities be planned

SEWAGE from the eastern Massachusetts area discharged into Boston Harbor constitutes no immediate menace to health, according to a report filed Dec. 2 for legislative consideration by a joint commission which has been investigating the effectiveness of existing disposal facilities for the past two years. The commission consisted of representatives of the health departments of the state and city of Boston, the metropolitan district commission and state department of public works. Present sanitary facilities, in the board's opinion are no criterion of continuing adequacy, and the report outlines a number of engineering steps which should be considered in planning to meet certain present drawbacks and future problems in disposal. It is hoped that the incoming legislature will formulate a long-range development program.

The results of the investigation show that although the south metropolitan sewerage and the Boston main drainage system appear adequate for some years for the removal of domestic and industrial wastes, they are not adequate to receive large quantities of storm water. Many parts of the north metropolitan sewer system are inadequate for the removal of the domestic and industrial sewage under average conditions and are inadequate for the disposal of storm water. Completion of the relief sewer now under construction by the metropolitan district commission should end surcharged conditions in the north system in the Aberjona River valley and Mystic Lakes area, but if pollution of the lower Mystic River and the Charles River Basin, now used extensively for recreation, is to be prevented, additional sewers must be built.

ESTIMATED COST OF PARTIAL TREATMENT

	Boston Main Drainage System	North Metropolitan Sewerage	South Metropolitan Sewerage
First cost of works consisting of bar screens and sedimentation tanks	$2,907,000	$5,539,850	$6,023,100
Capitalized cost of operation and disposal of sludge by barging to sea, to 1955 with interest at $3\frac{3}{4}$ per cent	3,300,000	7,190,000	7,560,000
Total cost of partial treatment to 1955	$6,207,000	$12,729,850	$13,583,100
Annual charges	$ 123,630	$ 269,910	$ 283,290

Harbor pollution increasing

Analyses show that Boston Harbor was more polluted in 1936 than in 1929 and 1930, but the amount of organic matter discharged into the harbor is as yet insufficient to cause a nuisance from the depletion of oxygen. Objectionable conditions were confined to the immediate vicinity of the main sewer outlets into the harbor. Under certain tide and wind conditions, grease and other floating matters characteristic of sewage reach the harbor shores from the main sewer outlets, and at times of considerable run-off sewage overflows from the main trunk and lateral sewers and reaches bathing shores. Bacteria characteristic of pollution did not appear in numbers to warrant the prevention of bathing except in the vicinity of sewer overflows and at Wollaston Beach. At times pollution in the Squantum, Hingham Bay, Winthrop and Aberjona-Mystic-Charles River basin areas has caused the state health department to restrict bathing. The board of engineers of the commission holds that it will be necessary to discontinue bathing as a precaution in certain areas or to make changes in the location of overflows or by treating sewage reaching main outlets.

Proposed remedies

The solution of the problem involves either changing the present methods of discharging sewage in Boston harbor by extending sewers to points more remote from the shore than at present exist, or installing sewage treatment works. Partial treatment appears more practicable at present, because extension of the present outfall sewer to a point in the ocean beyond the harbor limits in the vicinity of Graves Light would cost around $27,000,000, and unless the sewage were treated for the removal of grease and other floating matters, this pollution would probably reach the neighboring shores.

The investigation indicates that if treatment works are provided they need not have a capacity in the beginning to care for the flow contemplated beyond 1955 as future additions can be made as required. The first cost of such works for the districts under consideration, including the expenses of operation and of disposing of sludge, grease and floating matter by barging to sea, would be as shown in the accompanying table.

New equipment and additional maintenance are immediately needed for the three sewer systems to facilitate their operation and reduce the overflow of sewage into harbor tributaries. In this regard, the commission's board of engineers refers particularly to more adequate screening devices, pumping equipment and funds to maintain such devices and equipment to remove deposits from the sewers and drains.

The report includes a vast quantity of supporting data, studies of sewage flow with airplane photographs of sleek distribution on harbor waters, bacteriological analyses, experimental treatment results, drift of sewage, volumes of sewage, cost of barging, tests of screening, review of system development at Boston and much other information of value to the sanitary engineer and specialist in public health. It will soon be issued in printed form.

Rock Picker Takes Oversized Stone From Fills for Canal Banks

A new aid in soil mechanics lifts oversize rock from an 8-in. fill layer ready for compaction and saves cost of putting material through grizzly

A PIECE OF MACHINERY of importance in the field of soil mechanics has been in process of development since last June by practical trial on the extensive fills being compacted as part of the desilting plant at Imperial Dam on the Colorado River. The principle involved is a revolving inclined cage of cylindrical shape through whose sides fines can escape freely as the machine is moved along a recently spread layer of earth. Oversize rock is retained in the cage. Advantages claimed are saving of time and cost because the material can come from the borrowpit direct to the fill without the delay and expense of putting it through a grizzly, and a better job of compaction than otherwise would be possible.

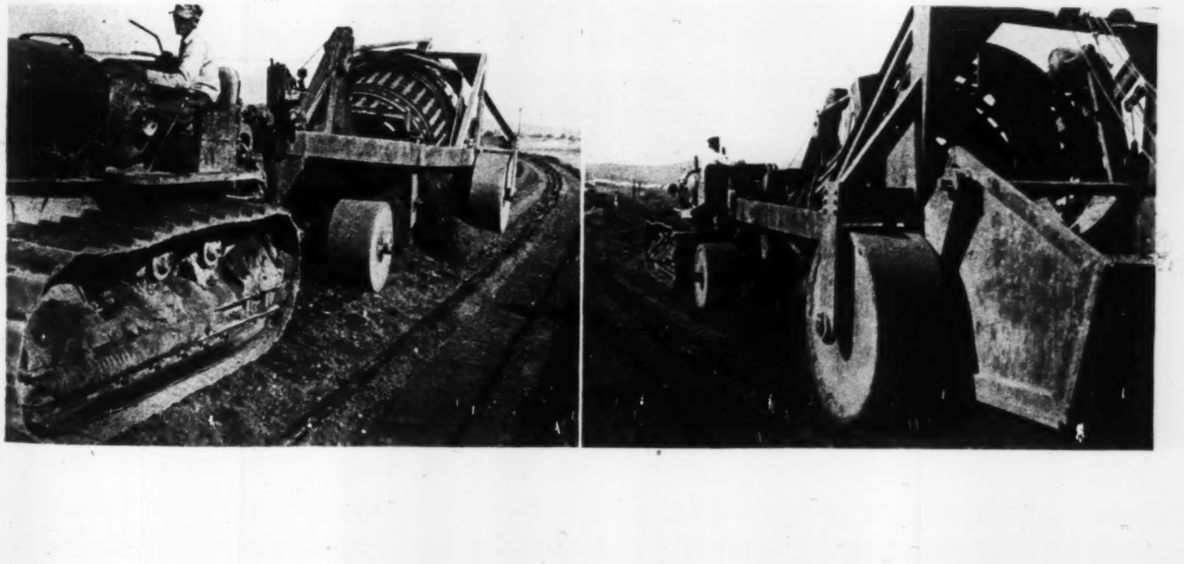
As the machine is pulled by a tractor the forward end of the rotating cylinder picks up a layer of material with a scoop-like motion which forces it back into the revolving cage. Longitudinal bars in the cage are set 5 in. apart so that fines pass out readily through the openings while stones over 5 in. in diameter are moved up the inclined cylinder by an internal spiral which is a part of and therefore rotates with the cylinder. The oversize rock thus is delivered to an 8-yd. hopper or compartment at the rear of the machine. These rejects can be dumped conveniently by backing the rear of the machine to a slope over which the hopper can be tilted.

As the material is delivered to the fill it is spread in the usual manner by bulldozer in layers 8 or 9 in. deep and about 8 ft. wide. The rock picker follows the bulldozer, taking the full depth of a layer for a 4-ft. width at each pass. Two passes thus are required to complete a layer 8 ft. wide. With the relatively small amount of oversize on the Imperial desilting basin job two or three round trips are made before enough rejects are accumulated to make it worth while dumping the bin. Prior to the advent of this machine the method of removing the oversize rock was by hand picking, as the quantity was not thought to justify putting the material through a grizzly. However, hand labor was unsatisfactory, particularly in the extremely hot weather that obtains much of the year at this location, and enough of the large stones escaped the hand pickers to decrease the efficiency of the petrolithic rollers.

Fill density improved

Before the rock picker was used a dry density between 108 and 109 lb. per cu.ft. was being obtained in the fills with material whose dry density in place in the borrowpit was 93 lb. per cu.ft. Due principally to better removal of oversize material in the fill after the rock picker was put in operation, the fill density then increased to about 112 lb. per cu.ft.

The builders of the rock picker have been observing its operation continually with a view to perfecting the mechanism. Numerous revisions have been made, such as improving the feed, strengthening the frame, experimenting with the pitch of the internal spiral and regulating the speed of rotation. As now operated the cage or cylinder is rotated by a separate gasoline engine which uses a transmission so that with gear changes the drive on the cage can be changed to suit conditions. The rock picker was built by the Crook Co., located in Los Angeles, Calif.



FIGS. 1 and 2—FRONT AND REAR VIEWS of the rock picker in operation showing how the earth layer is scooped up to pass through a rotating cylinder while larger rocks are moved upward by an internal spiral which drops them into the bin at the rear.

Heated Air Space Eliminates Frost Destruction in Tank Walls

Leaking filter tank walls permanently protected against disintegration from frost action by means of a heated air space around the exterior surfaces

By L. A. Marshall
and H. M. Whitmore

Superintendent of Filtration, Division Avenue Plant, and Engineer, Dept. of Public Utilities, Cleveland, Ohio, respectively

PROVIDING a heated air space around the exterior wall surfaces of leaking filter tanks is the unique scheme adopted at the Division Avenue water filtration plant in Cleveland to arrest the destructive effect of frost action. This interesting rehabilitation project was partly completed for service last winter, and the results thus far have indicated the success of this method for minimizing disintegration caused by temperature changes. The completion of this job is expected to mark the termination of a 20-year period of reconstruction work at the Division Avenue plant that began shortly after its construction, and to date is estimated to have cost over $1,000,000.

Plant foundation inadequate

When the plant was built in 1916, the design did not call for pile foundations although the site was in a region of peat and quicksand overlying a bed of stiff clay. As a consequence, structural failures of various kinds soon developed and kept recurring due to soil movement and settlement.

The plant, occupying an area of about 34 acres, includes a pumping station, filter building and a 20,000,000 gal. covered reservoir. Raw water is taken from Lake Erie and pumped through a 72-in. pipeline to mixing chambers and settling basins. From these basins the water flows to rapid sand filters, of which there are 36 separate units, housed in a building 750-ft. long. The filters are arranged in two rows of 18 each, on either side of a pipe gallery. The north wall of this building, the upper part of which constitutes the northerly enclosure of 18 of the filter tanks and the lower part of which serves to enclose the base on which the tanks are supported, is an exposed surface extending 23-ft. above the ground (Fig. 3). The space beneath the filters was originally intended for use as an effluent gallery, but was abandoned for that purpose because of structural reasons.

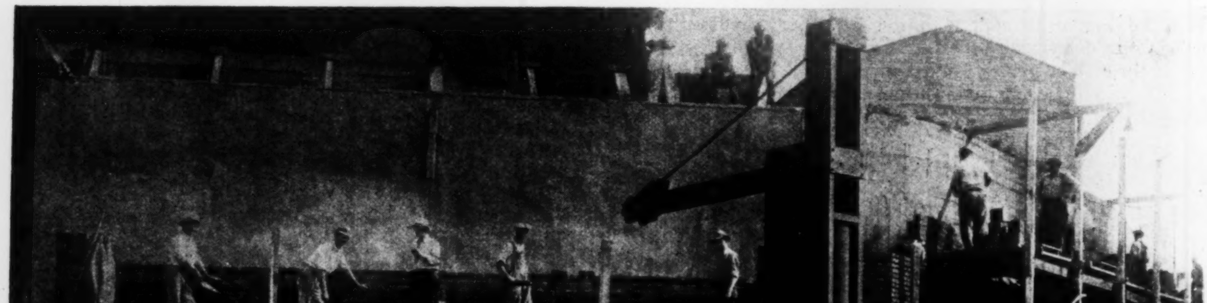
The reconstruction work that has been carried on from time to time during the past two decades included relining the filtered water reservoir, underpinning the effluent galleries and a part of the filter building with precast sectional piles, and the driving of sheet piling around three sides of the filter building in order to check ground movement. In addition, numerous structural cracks developing in the floors, roof, and dividing walls of the six settling basins required extensive repairs with copper expansion joints, and the placing of new concrete floors. The decks of the 18 north filters were also resurfaced with cinder concrete, and waterproofed with asphalt and membrane.

Filter wall leakage

Ever since the plant was put into operation, water has been seeping through the north wall of the filters due to structural weaknesses, porous concrete, and laitance-filled joints. The leakage occurred at three principal points, namely, (1) where the roof slabs join the parapet walls, (caused by faulty roof drainage); (2) through cracks and porous areas between the floors of the filter tanks and the line of the elevation of water in the filter tanks; (3) from the joint between the bottoms of the filter tanks and the concrete base on which they are built, the latter leakage being principally through the filter floors of the filter tank.

Frost action during the winter season caused serious disintegration of the concrete wall (Fig. 2). In some places the damage extended clear through the wall, and in other places reinforcing steel was exposed over large

FIG. 1—BRICK AND TILE WALL constructed 43 in. from the waterproofed filter tank wall provides space through which heated air is circulated to minimize temperature changes in winter and consequent cracking of thin plaster surface.



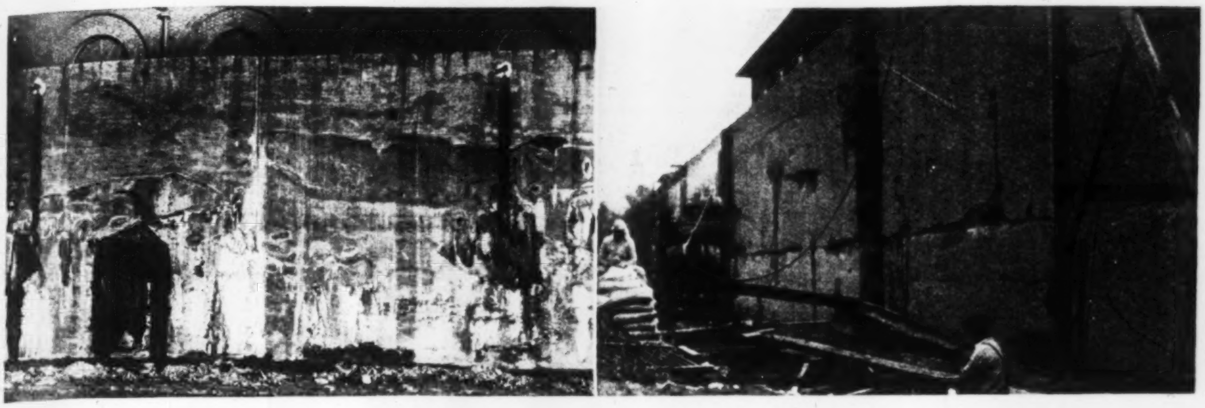


FIG. 2—DISTINTEGRATION of concrete filter tank wall (left) due to leakage and frost action. On the right is a view of the wall after it was cleaned, and bush-hammered preparatory to receiving a 1-in. surface coating of air-applied mortar.

areas. Attempts to remedy the condition by repair work both on the inside and on the outside surfaces of the filter tanks resulted in failure. Efforts to waterproof the inside using asphalt and membrane protected with mortar plaster coats or asphalt planks also proved impractical.

After considerable research and investigation, it was finally decided that no methods of waterproofing were available which would permanently and completely waterproof the filters under the conditions existing at this plant. Membranous materials were eliminated from consideration because of the impossibility of making continuous waterproofing layers and providing proper protection for these layers. Considering the probability of slight movement of the structure due to loading and unloading of the filters, and other movements due to thermal effects, all other methods of waterproofing known to us, such as plaster coats, cement coating, bituminous solutions, surface and penetrating materials, paints and varnishes, were abandoned.

With the exception of the plaster coat, it is probably true that these materials do have a use where it is desirable to either waterproof, dustproof or dampproof concrete. However, they are not well suited to permanently waterproof against a hydrostatic head when they are placed on the surface of a structure against which this head is exerted, and if placed on the opposite side they are not at all suitable. Besides, none of these materials is protection against the development of new cracks or movements at old ones.

Plaster coats, either reinforced or otherwise, when placed on the surface of a structure against which the hydrostatic head is exerted, may be successful in stopping leakage, but again they provide no protection against appreciable movements of the structure, with the consequent development of cracks.

Some consideration was also given to the feasibility of waterproofing the filter tanks on the inside by means of metallic lining, hot and cold vulcanized rubber sheets, spraying with latex, injection of waterproofing materials into cracks and crevices with high pressure guns, etc., but for one reason or another they were all rejected.

Frost action important

An important consideration in this particular case was the fact that the leaking structures are exposed to the severe winter weather conditions which prevail in this region. When water finds its way into the concrete through cracks and porous areas, it has been found that spalling takes place both on the inside and the outside of the structure due to frost action. Therefore, although a seal may be temporarily effected on the outside of the structure, if water continues to enter it from the opposite side there is danger of continued disintegration caused by freezing.

The program finally adopted for the repair of the filters was as follows: The sand, gravel and underdrain system were first removed from the tanks; cracks and unsound concrete were then cut out and refilled with non-shrink integral waterproofed concrete. After thoroughly bush-hammering the surfaces, new floors, 1½-in. thick, were poured; air-applied concrete plaster coats, 1-in. thick, were next applied to the inside faces of the north wall of the tanks.

The outside surfaces of the exposed north wall were treated in the same manner as the internal surface of the tanks.

It was not expected, however, that these measures would permanently eliminate the leakage. In order to arrest frost action in the concrete wall and on its wetted surface a new brick and hollow tile wall, 12-in. thick, located 43 in. from and parallel to the old wall, was built. The space created between

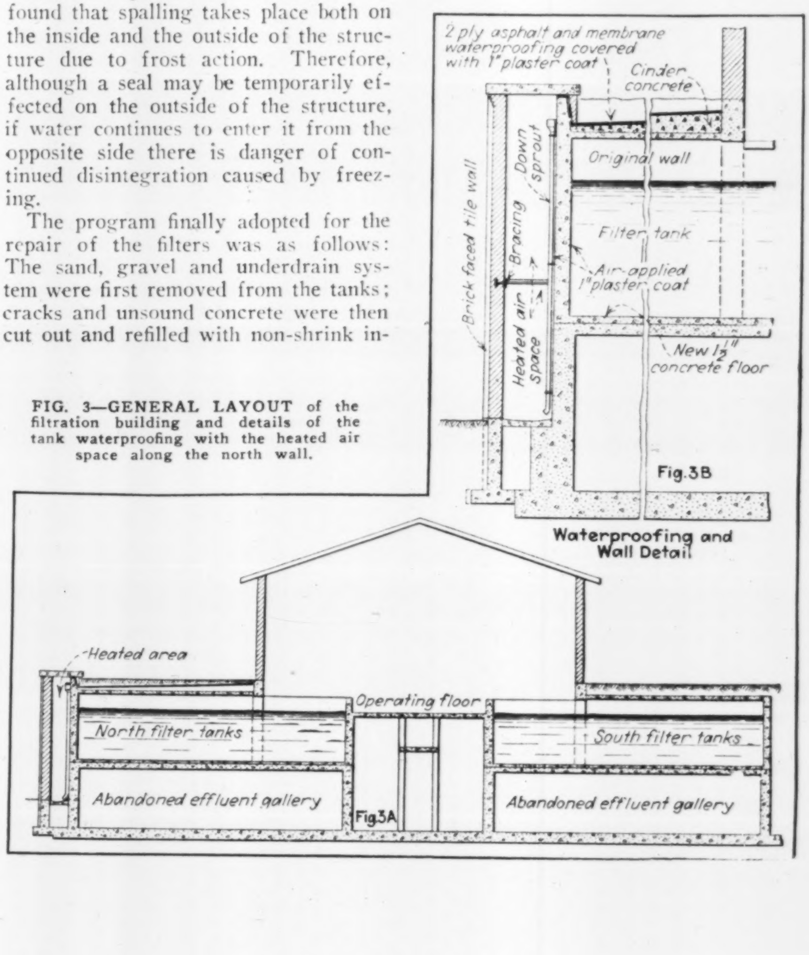


FIG. 3—GENERAL LAYOUT of the filtration building and details of the tank waterproofing with the heated air space along the north wall.

the two walls was closed at the top with a concrete slab. (Fig. 3). The temperature in the space between the new and old wall is kept above the freezing point in the winter time by circulating heated air by means of unit heaters and electric fans; temperature is automatically controlled by means of thermostats.

The new wall was built in two sections, and the west half was completed in time to put it into service last winter. It has now passed through all seasonal changes of the year and so far results have been highly satisfactory.

Personnel

The work described was recently completed under the direction of L. A. Quayle, chief engineer, and with the approval of Frank O. Wallene, director, department of public utilities. The writers were in charge of the supervision and construction operations.

Motor Car for Inspecting Inside of 36-in. Water Main

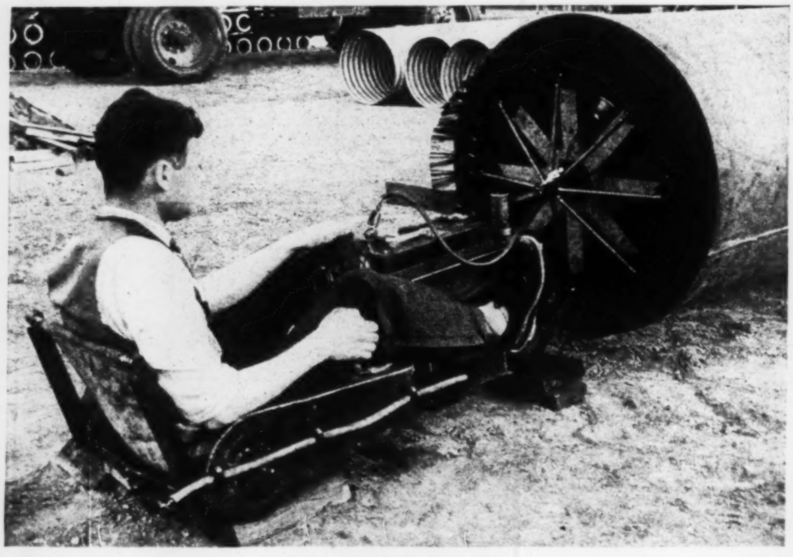
Labor-saving devices used for testing enamel in 15½-mile line—Motor and trailers carry men and equipment—Can pass through 11x18-in. elliptical manhole

By Howard Wait
Mechanical Draftsman, Los Angeles Bureau of Water Works & Supply

A NEW WATER PIPE 15½ miles long recently built by the Los Angeles Bureau of Water Works & Supply was an incentive to devise a better means of inspecting the interior of water mains. This particular main is 36 in. in diameter which would offer no serious problem as a limiting dimension in the design of a motor-propelled vehicle suitable for carrying an inspector and equipment. Requirements were made more difficult, however, by valves 20 in. in diameter and the necessity for taking the vehicle into or out of the pipe through 11x18-in. elliptical manholes. In addition to conveying inspectors through the line a major function of the equipment is to test the enamel with which the inside of the pipe is coated and to treat the "holidays" or small defects in this coating such as are found by the usual high-voltage brush test.

These several requirements have been met by a vehicle which is used even on grades up to 8 or 10 per cent, sometimes pulling two trailers with a total of three men. The conveyance has traveled 20 m.p.h. on level ground and once the writer attained a speed of 15 m.p.h. while backing inside the pipe line. It can be used for inspection and for conveying materials used in patching or placing enamel.

FIG. 1—MOTOR CAR designed for operating in a 36-in. water main. Operator's right hand is on brake lever.



The 36-in. pipe is delivered in 30-ft. lengths which are welded in the trench as fast as they are placed. After the weld has cooled it is cleaned and a primer is put on which must dry 24 hours before the enamel is applied. With construction schedules totaling 20 to 30 lengths of pipe per day the open end of the line frequently is 3,000 ft. from a joint to be enameled. As 9 in. of the pipe is left bare on each end pending welding, an 18-in. band must be enameled at each weld after the weld is completed.

The 20-in. valves are spaced approximately every half mile and any equipment used in the pipe must be removed from the line (frequently through a manhole) when not in use. Anything left in the pipe would be in danger of immersion when the line is flooded by accident or by intention in case it becomes necessary to fill the line to prevent floating out of a rain-filled trench. Secondary considerations were that the rigid wheel base of the carriage could not be long because of angles in the line. The gage had to be narrow so wheels would not ride up on the sides of the pipe where friction would increase motive power requirement. Finally, dimensions of the operator's person had to be taken into account.

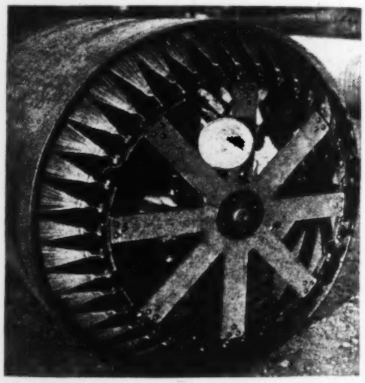


FIG. 2 — HIGH-VOLTAGE brush for detecting flaws in enamel, shown in operating position. Entire periphery is swept at once.

The motor car itself

Essentially the motor car is composed of three parts: a battery box, a right- and a left-wheel unit. The battery box serves as a chassis to which the other units are attached. Two 150-amp.-hr., 6-volt storage batteries are used, connected in series and mounted one above the other. With this arrangement only the width of one battery, about 7 in., is an interfering dimension and this is easily straddled. Braking is accomplished by means of a fiber shoe which may be pressed against the tire of the right wheel by a hand lever. On the left wheel unit a starter generator such as is used with automobile engines is coupled to the single driving wheel by chain and sprocket. The motor can be reversed by shifting the brush ring. The starter button is operated by the right foot and a spring clip on the end of a flexible lead permits the motor to be operated at voltages ranging from 6 to 12 in 2-volt stages.

The rear wheel units are attached to the battery box by a vertical piano-type hinge and a hinged spreader holds the two units at the proper gage. Each wheel unit is a separate mechanism and can be dismounted bodily. A canvas seat is suspended in the space between the rear wheel units, thus putting the bottom of the seat 2 in. lower than the tread of the rear wheels and making the full diameter of the pipe available for head room. The battery box mounting carries the single front wheel and also the steering wheel. The latter duplicates the three wheels on which the vehicle travels and may be detached for use as a spare. Conventional cable steering gear to the front wheel kingpin is used. The carriage thus assembled has a wheel base of 36 in., a rear wheel tread of 18 in. and weighs, with two 70-lb. batteries and without driver, about 260 lb.

The high voltage test is applied by 40 wire brush units mounted in sets of five on eight hinged segments. When expanded into the operating position the brushes make an angle of 60 deg. with the surface of the pipe in the direction of travel. An umbrella-type mechanism permits collapsing the segments toward the rear so brush ends clear the pipe by 3 or 4 in. The eight-segment spider supporting the brushes is made of plywood and the arm on which the detector assembly is mounted is clamped to a stud on the steering sector so that when the brush is expanded it acts as an automatic pilot.

Functions performed

Potential for the brushes is supplied by an induction coil (from a model T Ford) mounted on the side of the battery box. The brushes subject the enamel to a potential of about 10,000 volts. As the carriage moves forward at 2 or 3 m.p.h. the entire periphery of the pipe continuously is swept by this high potential. The enamel, with its normal thickness of 0.10 in., withstands this voltage if there are no flaws. The slightest opening, however, causes a visible and audible spark as the brush passes. Although the brushes indicate the location of a defect anywhere in the circumference while traveling at fairly rapid speed, the telltale spark has come and gone before the inspector can stop the carriage. Exact location of the defect therefore is determined by wiping the suspected area by hand with a small wire brush connected to the same spark coil. This is done by a second man riding in a trailer. When exactly located, the spot is covered with enamel by the man in the trailer. So effective is this method of inspection that an occasional defect has been found between joints, that is, in the work already tested very carefully at the enameling plant.

After one instance of striking a 20-in. valve without slowing speed, a warning band of whitewash was applied near each valve to warn inspectors. To pass a valve the carriage is sufficiently collapsed by lifting out the seat brackets, folding the hinged spreader bar, lifting off the steering wheel and the top battery. Frequently only one battery is carried as the motor develops enough power on 6 volts to propel the carriage at ample speed for detecting and inspecting. For passing through an 11x8-in. manhole the two halves of the brush spider are taken apart and batteries and rear wheel units are removed from the battery box.

H. A. VanNorman is chief engineer and general manager of the Los Angeles Bureau of Water Works & Supply. The equipment described was designed by the writer under supervision of L. E. Goit, chief draftsman, and is used under the direction of Thomas Brooks, superintendent of the street mains division. Some features of this equipment were suggested by a motor car for pipe inspection developed by J. G. Eernisse, of the Department of Public Utilities at Tacoma, Wash.

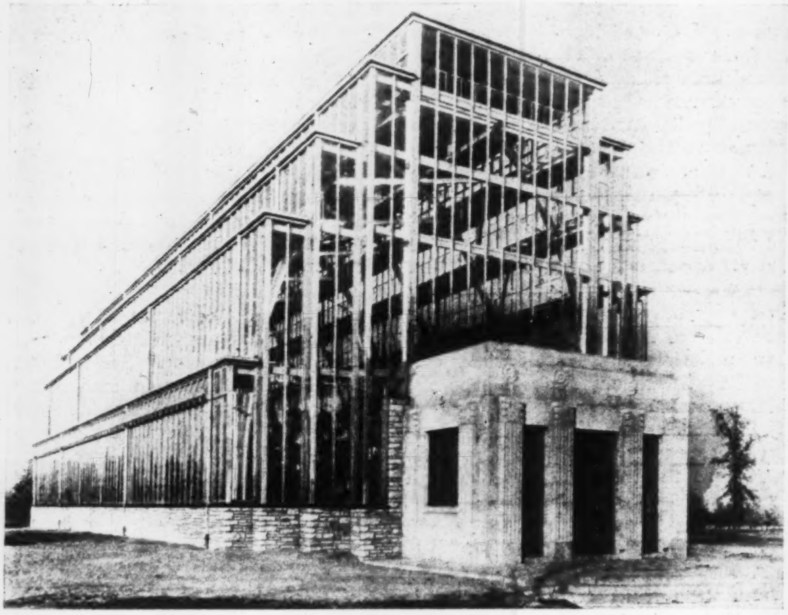
Heavy Loads Via "Airwheelbarrow"

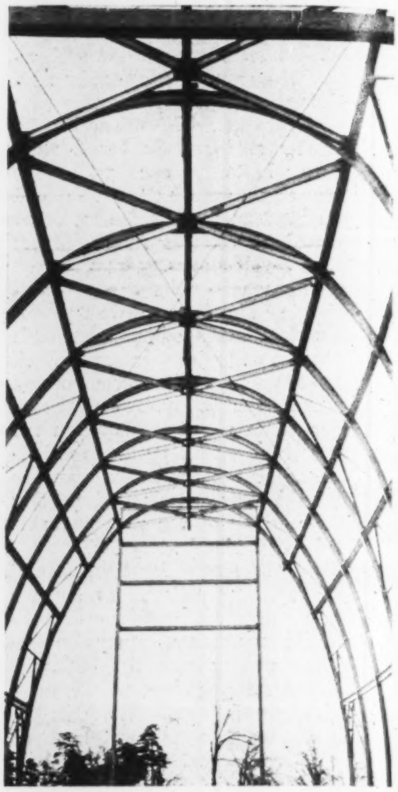
A low-pressure pneumatic tire substituted for the iron wheel of the ordinary wheelbarrow has greatly increased the weight of loads that can be moved quickly and easily by a single man at the R. G. LeTourneau Inc. factory at Stockton, Calif. The ease with which one man can propel a wheelbarrow so equipped plus the readiness with which it passes over irregularities or small objects such as nuts or bolts lying on the floor, has increased efficiency at the plant enough to warrant using this type of wheelbarrow or "airwheelbarrow" exclusively.

The dimensions of the one shown in the accompanying illustration are as follows: width of bed 30 in., bed length 24 in., height above ground 9 in. The wheel is a standard, 12x5x3 air wheel. The load shown is a Carryall wheel hub, weighs 290 lb. However, loads up to 700 lb. are handled successfully on an "airwheelbarrow" of the type shown in the accompanying illustration.

A three-wheel shop buggy with a bed 3 ft. wide and 5 ft. long 19 in. above ground, equipped with three 7.00x4 air wheels is also found very convenient around the shop. With the buggy the workman has nothing to lift and the swing of more than 180-deg. of the front wheel makes it easy to maneuver where exact placement is an advantage. The shop buggy frequently is used for loads of more than 1,000 lb.

A WHEELBARROW equipped with a low-pressure pneumatic tire has been found to increase the load that can be transported easily. The low-pressure tire also reduces the need for a smooth runway.





SOMETHING NEW in greenhouse construction is offered by this municipal conservatory at St. Louis whose stepback roofs defer to hailstones and not to architectural desires. At the right is shown the structural framing that supports the glass enclosure.

Greenhouse with Solid Flat Roofs Built to Resist Hailstones

ON ONE OF THE HIGHEST pieces of ground in Forest Park, St. Louis has recently built a new floral conservatory whose design is said to mark the first radical change in greenhouse construction in many years. The novelty is evident particularly in the setback solid roof construction in contrast to the usual glass which was a fair target for every hail storm. But the building is also unique in utilizing elliptical arches for its main framing and copper for all exterior metal, to eliminate painting.

Cutting down the light by the solid roofs required careful study since it might impair the efficiency of the building. Model experiments therefore were carried out which in the end determined not only the glass wall area and the roof widths but also the selection of arch instead of vertical column supports.

The conservatory is 186 ft. long by 55 ft. wide in outside dimensions and 55 ft. high. The display room, free of columns, is 144x52 ft. and 50 ft. high. The side walls are terraced to a central roof 24½ ft. wide. The first terrace 17½ ft. above the ground is 2½ ft. wide, the second 13 ft. higher is 4 ft. wide, the third 7 ft. higher is 4 ft. wide, the fourth 6½ ft. higher is 4½ ft. wide, while the top roof is 5½ ft. above the fourth. The total glass area of 16,654 sq.ft. includes four thousand 24x26-in. panes.

The main framing consists of eight elliptical rolled-section arches. Four lines of longitudinal I-beams on each side brace the arches and provide supports for the U-bar uprights that carry the glass frames. K-bracing of angle members is used between the arches in the end panels and the center panel, while horizontal X-bracing of I-sections is used between the two top stringers. The design is said to have been made to resist a 100-mile wind. The outside metal surfaces are green, attained by acid treatment of copper metal; inside, aluminum paint is used.

Models determine roof widths

In the model studies, two wooden models were used, each built on a scale of 1 in. per foot. In one model, six narrow wooden roofs at receding levels were used all supported by horizontal and sloping members framed into vertical columns. In the second model the interior columns were replaced by the arches; also this model had five instead of six roof levels. The model studies were undertaken to obtain light readings for the complete annual cycle of the rays of the sun. The models therefore were erected upon a ball and socket joint 6 ft. above the floor permitting them to be tilted to reproduce the angle of the sun throughout the year at the building location. Comparing readings taken inside and outside the models, it was shown that throughout the year the light average inside the first model was 28 per cent and inside the second [illegible]2.9 per cent. Both models were unglazed, so that the differences in the light intensity gave a measure of the obstruction caused by the two types of roof and framing. The model work was done by Prof. H. R. Grummann of the mathematics department of Washington University.

The building is equipped for scientific operation. The basement under the rear end of the building contains the heating plant consisting of an automatic oil-fired boiler and also a manually-fired coal or wood boiler for emergency service. Since no reliable scientific data on the relative efficiency of radiators, pipe coils or convectors could be discovered, the city chose wall-type radiators and made provisions for expansion of the system, particularly at an upper level, if it is found necessary.

Ventilation is provided by manually operated movable sash along the entire length of glass at the top of the first setback. Another line of movable sash just under the high roof level is motor operated from a push button control. All water condensation will drain off to adjacent roofs, a perforated brass strip having been provided at the base of the glass walls. The building cost $108,000, and was designed by William C. E. Becker, engineer, bridges and buildings, City of St. Louis.

Filter Sand Permeability Studies

Tests at Iowa Institute of Hydraulic Research Provide a Practical Basis for Determining Permeability Coefficients and the Velocity of Flow Through Filter Sand

By **F. T. Mavis and E. F. Wilsey**

Head of Mechanics and Hydraulics, University of Iowa, Iowa City, and Assistant Engineer, U. S. Bureau of Reclamation, Denver, Colo., Respectively

NUMEROUS FORMULAS have been proposed for determining the co-efficient of permeability in filter sands, but there is a lack of published data which afford a basis for determining necessary coefficients from information usually available to the hydraulic engineer. This coefficient, k, is a function of the viscosity of the liquid and of the porosity, size, shape and gradation of the granular material. It is one of the elements in Darcy's formula for the flow of water through sand filters, in which:

$$v = k\frac{h}{l}$$

Where: v = apparent velocity of flow; obtained by dividing the rate of discharge through a filter by a cross-sectional area of the filter.

k = the coefficient of permeability, dimensionally the same as the velocity, v

$\frac{h}{l}$ = the hydraulic gradient, the ratio of head loss in feet of fluid to the length of the sand column in which the loss occurs.

Tests made at the Iowa Institute of Hydraulic Research in 1934-1935 provided data from which it is possible to determine the coefficient of permeability of a sand, and its mean relative probable error, from mechanical analyses of the material and a knowledge of its porosity, shape of grains, and temperature of the water. Washed sand from the Iowa River at Iowa City and Standard Ottawa sand were used in the tests. The Iowa River sand was tested as (1) pit-run sand, (2) as unigranular sand (separated by sieves in geometrical series of $\sqrt{2}$) from 0.39 mm. to 1.98 mm. average diameter, and (3) as artificial mixtures in which the uniformity coefficient was under laboratory control. The Standard Ottawa sand grains ranged in size from 0.68 mm. to 0.93 mm.—an average diameter of 0.80 mm. Specific gravities of the two sands were 2.63 and 2.64, respectively, for all materials tested as unigranular samples. Mechanical analyses of mixtures tested are shown in Fig. 1.

The tests were conducted in a permeameter of 6 in. diameter and 3 ft. high. Head losses were measured between two piezometers 18 in. apart, the lower piezometer being 3.5 in. above the bottom of the sand. Water temperatures were controlled manually by adjusting valves in the hot and cold water pipes supplying a 30-gal. mixing tank. The flow through the permeameter was regulated by means of a constant-head tank in the supply line and an overflow in the discharge line. Rates of flow were determined by weighing and timing.

The sample of sand to be tested was heated to dryness, weighed, and placed in the permeameter while it was still hot. Hot water was then allowed to percolate slowly upward through the sand and this expelled most of the air entrained in the pores. The hot water was allowed to course through the sand under a head of 0.1 ft. for 30 min. After the water was shut off the permeameter was allowed to cool over night.

During a test the temperature of water in the constant-head tank was maintained at slightly above room temperature from a minimum 52 deg. F. during the winter to 76 deg. during the spring. In any one test the greatest permissible temperature range was 0.5 deg.

Head losses were measured by hook gages with a tolerance of 0.001 ft. between initial and final readings in any given test.

In one series of tests water was allowed to percolate through a sam-

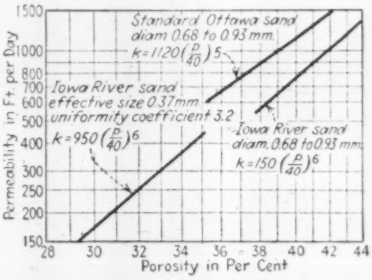


FIG. 1—MECHANICAL analyses of blended samples of Iowa River sands.

FIG. 2—EFFECT of porosity on the coefficient of permeability.

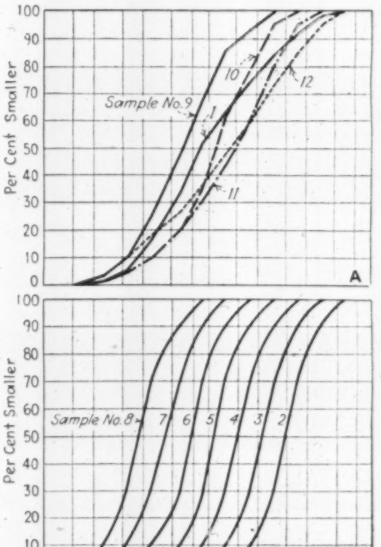
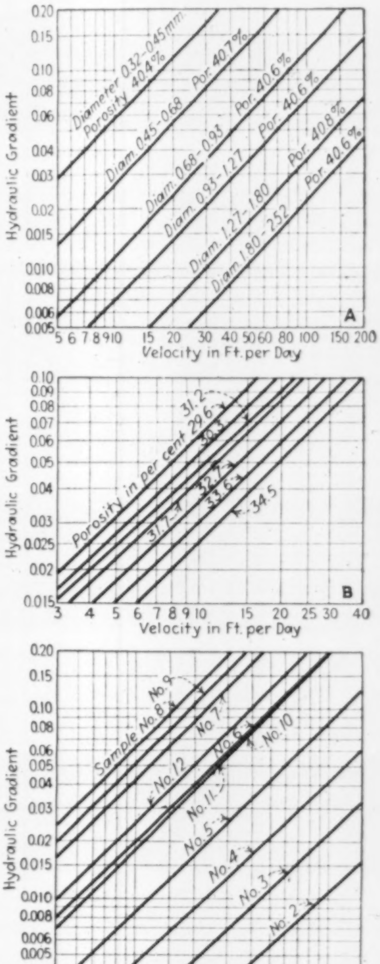


FIG. 3—Summary of tests showing the relationship between apparent velocity of flow through a sand column of Iowa River sand and the hydraulic gradient; (A) refers to uni-granular samples, (B) through pit-run samples, and (C) through blended samples.



ple of sand for a period of five days, the hydraulic gradient being maintained at 0.035 between tests. At the end of each day the permeability of the sample was determined. The tests showed that there was a progressive reduction in the permeability coefficient from day to day, the value determined after five days of continuous filtration being about two-thirds of that determined after one day. This reduction, however, appeared to approach a limit suggesting that if the tests had been further prolonged the limiting permeability coefficient might have been of the order of one-half the value determined on the basis of the first day's test.

Permeability and viscosity

The coefficient of permeability was found to vary inversely as the coefficient of viscosity of the water flowing through the sand. The coefficient of viscosity of water, μ, for temperatures, t, between 32 and 105 deg. F. can be represented (within 5 per cent) by

$$\mu = \frac{0.78}{t + 10} \text{ (dyne-sec. per sq. cm.)} \quad (2)$$

Hence the coefficient of permeability is directly proportional to the temperature factor proposed by Allen Hazen, viz.,

$$\left(\frac{t + 10}{60}\right)$$

The effect of porosity on the coefficient of permeability was determined by testing (1) a unigranular sample of Standard Ottawa sand ranging in grain size from 0.68 to 0.93 mm., (2) a unigranular sample of Iowa River sand of the same grain size, and (3) a pit-run sample of Iowa River sand having an effective size of 0.37 mm. and a uniformity coefficient of 3.2. In Fig. 2 are shown the observed permeability coefficients (at 60 deg. F.) plotted against the corresponding porosities of the respective samples tested. The permeability coefficient for the angular Iowa River sand varied as the sixth power of the porosity while the coefficient for the rounded Ottawa sand varied as the fifth power.

The effect of grain shape on permeability was not studied in detail. The tests showed, however, that the coefficient of permeability of rounded Standard Ottawa sand was 50 per cent greater than that for angular Iowa River sand for samples having the same grain-sizes and porosities.

Effect of grain size

Six unigranular samples and twelve blended samples of Iowa River sand were tested to determine the effect of grain size on the permeability coefficient. The mechanical analyses of blended samples are shown in Fig. 1. The experimental data were analyzed: (1) By correlating permeability with mean grain size for unigranular samples; (2) By correlating permeability with the "effective size" for mixtures; and (3) By correlating permeability of unigranular materials and mixtures to determine an "equivalent grain size" for the mixture.

Effective size defined

As used here the term "effective size" is defined as the diameter of sand grains, in mm., such that 10 per cent by weight of a representative sample is of smaller grains and 90 per cent is of larger grains. The term "equivalent grain size" is defined as the diameter of sand grains, in mm., such that if all the grains of a given representative sample were of that size, the calculated permeability of the sample would be unchanged for the same temperature and porosity.

A summary of the tests of unigranular samples is shown in Fig. 3A. Ordinates show the hydraulic gradient and abscissas the corresponding apparent velocity of flow through the sand column in ft. per day at a temperature of 60 deg. F.

The data shown in Fig. 3A are represented by the formula:

$$v = 980\, d^2 \left(\frac{p}{40}\right)^6 \left(\frac{t + 10}{60}\right) \frac{h}{l} \quad (3)$$

where:

v = apparent velocity of flow through sand column, in ft. per day.

d = diameter of sand grains, in mm.

p = porosity of sample, in per cent of loose volume.

t = temperature of water, in deg. F.

$\frac{h}{l}$ = hydraulic gradient.

The mean absolute deviation between observed velocities and velocities computed by formula (3) is two per cent.

A summary of the tests of pit-run Iowa River sand, (sample No. 1 in Fig. 1) is shown in Fig. 3B. A corresponding summary for blended samples (Nos. 2 to 12, inclusive, in Fig. 2) is given in Fig 3C.

SUMMARY OF PERMEABILITY TESTS OF BLENDED IOWA RIVER SAND

Sample No.	Effective Size d_e in mm.	Uniformity Coefficient	Observed c in Formula (4)
1.........	0.38	3.2	2,330
2.........	1.80	1.8	2,430
3.........	1.27	1.9	2,380
4.........	0.93	1.9	2,380
5.........	0.68	1.7	2,230
6.........	0.45	1.8	2,170
7.........	0.32	1.8	1,960
8.........	0.23	1.8	2,250
9.........	0.32	2.5	1,620
10.........	0.45	2.8	2,310
11.........	0.45	4.0	2,260
12.........	0.32	5.6	3,300
			Mean = 2,300

Mean absolute error 10 per cent

An analysis of these data showed that if the "equivalent grain size," d, is defined as the diameter such that one-third by weight of the sample is of smaller grains and two-thirds is of larger grains, formula (3) may also be used for computing the flow of water through the mixtures. The mean absolute deviation between observed velocities and velocities computed by formula (3) for the mixtures was 15 per cent if d is the diameter of the largest grains in the finest one-third (by weight) of sample.

In the table are shown the effective size and uniformity coefficient for the mixtures tested as well as coefficients, c, in Hazen's formula converted to velocities in ft. per day. (The term "uniformity coefficient" as here used is defined as the ratio of the size of grain which has 60 per cent of the sample finer than itself to the size which has 10 per cent finer than itself.)

$$v = c\, d_e^2 \left(\frac{t + 10}{60}\right)\frac{h}{l} \quad (4)$$

The results from formula (4) (in which c = 2,300 ft. per day) agree more closely with observed data than those derived from formula (3). The mean absolute deviation between observed velocities and velocities computed by Hazen's formula (4) is ten per cent. The greatest deviation is for sample No. 12 whose uniformity coefficient is outside the limit (5.0) set by Hazen for use of formula (4).

Conclusions

The tests of the Iowa River sand and of Standard Ottawa sand showed that:

(1) The coefficient of permeability varied inversely as the coefficient of viscosity of the water.

(2) The coefficient of permeability for the angular Iowa River sand varied as the sixth power of the porosity, and for the rounded Standard Ottawa sand it varied as the fifth power of the porosity.

(3) The coefficient of permeability of a sample of sand varied as the square of the diameter of sand grains.

(4) The coefficient of permeability of rounded Standard Ottawa sand was 50 per cent greater than that of angular Iowa River sand for unigranular samples having the same grain-sizes and porosities.

(5) The velocity of flow through unigranular samples of Iowa River sand may be computed by formula (3) with a mean absolute error of 2 per cent. The velocity through blended samples of Iowa River sand may also be computed by formula (3), with a mean absolute error of 15 per cent, if d is the diameter of the largest grains in the finest one-third of the sample by weight.

(6) The velocity of flow through blended samples of Iowa River sand may be computed by Hazen's formula (4) with a mean absolute error of 10 per cent.

Difficult Rock Blasting Job Widens Road at Oregon City

Rock layer 20 ft. thick removed from the face of basalt cliffs 120 ft. high in close proximity to railroad and factory buildings

By E. A. Collier
Division Engineer, Oregon State Highway Department

THE PACIFIC HIGHWAY enters the business district of Oregon City, 12 miles south of Portland, Ore., on a bench cut which, because of its narrow width has been a "bottle neck" since modern traffic conditions developed. If a simple solution had been possible, improvement would have been made long since. Steep grades incidental to leaving the riverbed made it impracticable to reroute the road; widening was prevented by the main line of the Southern Pacific R.R. flanked by the Willimette River on one side and high rock bluffs on the other. As traffic has developed in recent years, the Pacific Highway has been widened elsewhere to a four-lane width as it approaches cities; hence restriction to a two-lane width near cities has become a serious drawback.

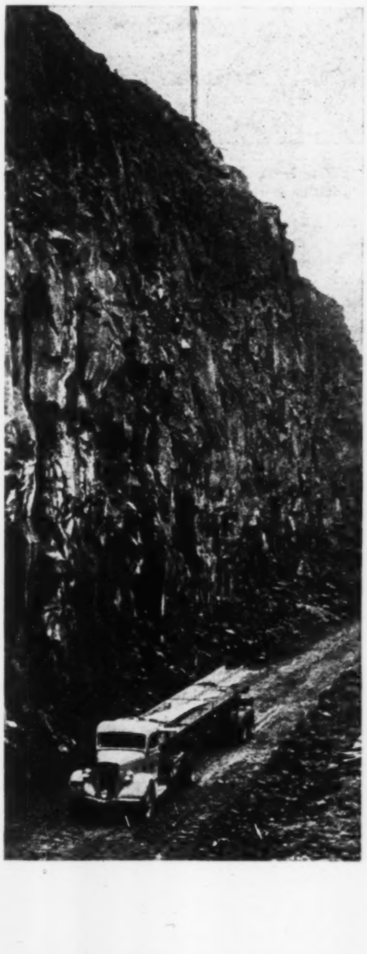
Early in 1936 work was begun on a plan for widening this Oregon City approach to afford a four-lane roadway. This work affects a ½-mile length of road mostly at the base of cliffs whose height ranges up to 120 ft. where the highway turns to go through an underpass beneath the railroad. Essentially the problem was to remove a vertical slice, 20 ft. thick, from the face of the cliffs, construct a new and wider underpass and to accomplish these improvements without interrupting railroad schedules, industrial activities or creating hazard to life and property.

Highway traffic was detoured over city streets and drilling started at the top of the bluffs with wagon drills, spacing the holes about 4 ft. apart. The holes were put down 20 ft. and were aligned on a ¼:1 slope. The rock is a hard basalt containing some strata of softer material. Experienced powder men using ½ lb. of 40 per cent dynamite per cubic yard of rock, were able to break it loose uniformly and lay it at the foot of the bluff without damage to the nearby structures.

Remarkable success was attained by rock excavation crews and very few of the blasts resulted in "flyers" or fragments that went beyond the desired limits for the bulk of the material moved. The ideal objective was to deliver all of the blasted rock to the old roadway with none on the adjoining track. The degree to which this objective was attained is indicated by the fact that the rock work caused no delays in rail traffic and only two rails had to be replaced as the result of breakage caused by rock fragments falling on the track.

The bid price for the rock excavation was $1.45 per cu.yd. Four compressors were used; after the top lift was off subsequent drilling was done with jackhammers operated by men supported on ropes. The quantity moved totaled about 60,000 cu.yd., all of which was picked up on the old roadway level by 1½-cu.yd. power shovels and hauled away in 5-yd. trucks. Near the south end of the job, where the road is at a higher level and commands a view of the river and Oregon City Falls, a masonry parapet wall has been constructed on the outer side of a long parking area. A considerable quantity of excavated rock was used in building up this parking area on a steep slope not useful for other purposes.

FIG. 1—BASALT CLIFFS that had to be cut back to widen the narrow roadway at their base.



Difficult underpass work

Second only to the "face lifting" operation performed on the bluff, a feature of the job calling for careful planning was the construction of an underpass beneath the railroad. This structure must take a four-lane highway around the sharp curve involved in getting away from the cliff and under the tracks. The underpass design calls for a clear roadway width of 42 ft. with a separate pedestrian tunnel of 5 x 8-ft. section. Before starting excavation for this structure it was necessary to support the tracks on temporary piling driven through earth and boulders. Also it was necessary to break up and remove a concrete retaining wall on which support for the railroad foundation depended. Here again care in placing the shots was a fundamental requirement.

The four-lane roadway will cross under the three tracks of the railroad on a 22-deg. curve with a 45-deg. skew at center line. The main support for the track consists of 36-in. I-beams 47 ft. long, of which 42 were required.

The difficult work of blasting and trimming up the rock slope has been finished by the first of the year and the project as a whole was about 70 per cent completed with traffic over the new roadway scheduled for May, 1937.

Considerable study was given to treating the surface of the cliff to prevent rock from falling. It was first considered that it would be desirable to use a shotcrete coating. However, the rock is very compact and it was decided that no advantage could be gained in this way because of the narrowness of the crevices. The face of the cliff has been gone over several times to work out all loose rock that might possibly fall. It may be necessary to go over the face of the cliff again in the future and if hazard then is apparent some method of treating the surface will be used.

Construction of the temporary trestle to support the railroad track and other incidental work on the railroad right-of-way was done by Southern Pacific forces. Parker and Schram held the contract for the excavation and credit for the effective placement of the powder charges goes to Charles Parker. The total cost of the project is estimated at $315,000; financing was made possible by federal aid. The project was carried out under the direction of R. H. Baldock, state highway engineer, represented on this job by Frank Young, resident engineer on the grading, and Marshall Dresser, resident engineer on the underpass.

Progress in San Jacinto Tunnel

About 5½ miles yet to be driven—Inclined adit being driven to supplement main headings and pioneer bores—West portal now a drainage vent.

IN THE 13-MILE San Jacinto tunnel which has been regarded as the limiting factor in completion of the Colorado River aqueduct, 26,384 ft. remained to be driven on Jan. 15. This distance is being reduced steadily as the two main headings approach each other, driven by crews of the Metropolitan Water District of Southern California. Meantime three expedients which are expected to hasten completion are being tried. Two of these are pioneer headings (driven parallel to the main tunnel at either end) and the third is Lawrence adit, a 25 per cent incline now being put down about midway between the two approaching headings. At the rate of progress in the main headings in recent months it is estimated that, disregarding incline and pioneer bores, the two main headings would hole through about the end of June, 1939. If additional headings in the main tunnel can be opened up either from the incline or from the pioneer bores the completion will be speeded by the amount of heading advance accomplished in this way.

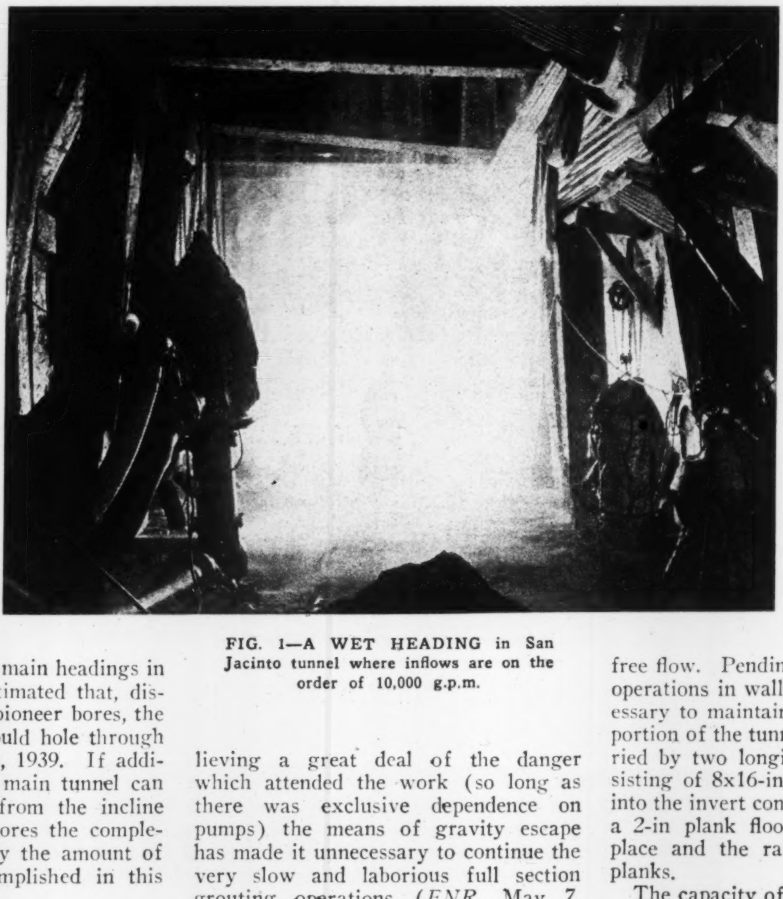


FIG. 1—A WET HEADING in San Jacinto tunnel where inflows are on the order of 10,000 g.p.m.

Completion of the 15,500-ft. length of main tunnel from Potrero shaft to west portal has aided the work materially in that the large quantities of water flowing into the Potrero east headings now can escape by gravity. Also the experience of the district in handling the heavy inflows (*ENR*, Aug. 22, 1935, p. 252) and the methods of carrying on the work have been more or less standardized. Methods and progress in driving Lawrence adit were described in *ENR*, July 23, 1936, p. 110. Recent rates of progress and the present construction program are outlined in the following.

With the holing through of the Potrero west-west portal section, the difficult situation in handling water from Potrero east has changed materially. An outlet through west portal gives a means of escape by gravity for the large inflow into the tunnel and in addition to relieving a great deal of the danger which attended the work (so long as there was exclusive dependence on pumps) the means of gravity escape has made it unnecessary to continue the very slow and laborious full section grouting operations (*ENR*, May 7, 1936, p. 661) which materially delayed driving operations in earlier stages. When very heavy flows are encountered now, driving operations are not interrupted to grout off the inflowing water. Rather, the heading is advanced through the wet zone, the water is allowed to escape by gravity and later on, when this can be done without interfering with heading advance, concrete lining is put in to shut off the heavy inflow.

For a while the escape of water through the west portal was by means of a 30-in. pipe. Much of the time this pipe line operated under a pressure head and even so occasionally had to be aided in disposing of the full flow by partial operation of the pumps at Potrero shaft. Meanwhile lining operations were advanced, working in from the west portal as far as Potrero shaft, and the design of the concrete invert was revised so it would have maximum capacity as a trough for discharging water.

The concrete lining was put in in three steps. First a curb or footing was poured on either side. This was followed by a second operation which poured the invert proper from curb to curb. The third pour, consisting of walls and arch. By changing the 32-ft. radius which was the originally planned curvature of the invert, to a 16-ft. radius, the capacity of the concrete trough so formed was increased to about 8,300 g.p.m. in free flow. Pending completion of lining operations in walls and arch it was necessary to maintain a track through this portion of the tunnel. The rails are carried by two longitudinal stringers consisting of 8x16-in. timbers bolted down into the invert concrete. On top of these a 2-in plank floor is spiked firmly in place and the rails are spiked to the planks.

The capacity of the invert with water level up to the bottoms of the plank floor is about 8,300 g.p.m. Although a somewhat greater total amount has been flowing into the tunnel, use of some of the pumps at Potrero shaft reduces the quantity discharged by gravity to the amount that can be handled conveniently in the invert below floor level. When the lining is completed and the track removed it is expected that the Potrero pumps will not be required longer. Lining of the walls and arch in this portion of the tunnel started Nov. 12 and was completed Jan. 17, 1937. The rate of placing concrete in the walls and arch has been about 225 lin.ft. per day.

When the district took over the driving of Potrero east heading, which had

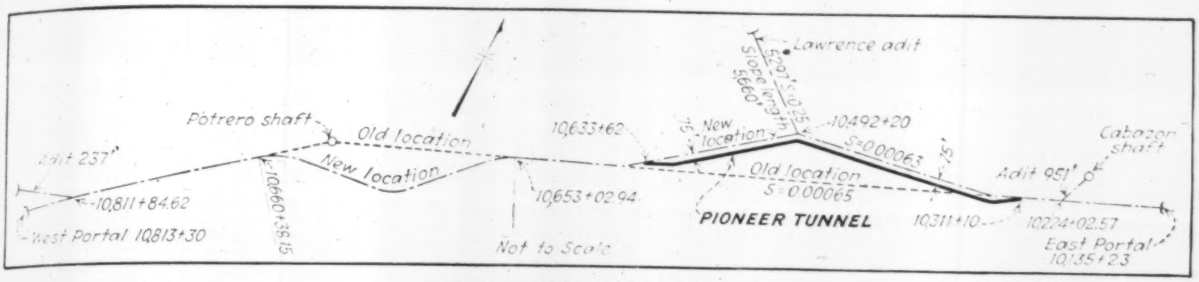


FIG. 2 — PLAN showing main and pioneer headings, incline shaft and the alignment changes decided upon as the work has proceeded. A plan to scale appeared in *ENR* July 23, 1936, p. 110.

been started under contract, it was decided to make an offset in the tunnel line so as to bypass the zone of disturbed material from which several "runs" into the tunnel had occurred. Beyond this detour the alignment was expected to follow the location originally planned, as shown in Fig. 2, but at a later date it was decided to change the alignment again to make it feasible to tap the main tunnel with the proposed Lawrence inclined adit.

Potrero east

In recent months the water flowing into Potrero east has remained about the same. The flow in the face has decreased somewhat but as the tunnel becomes longer the inflow in the greater length has to be included so the total remains about the same. An average condition in November was an inflow of 7,400 gal. per min. from the main heading and 1,700 from the pioneer bore. Of this total 2,800 g.p.m. was pumped up Potrero shaft and the remaining 6,300 g.p.m. went out as a gravity flow through the west portal. By reason of 1,000 g.p.m. picked up in the tunnel west of Potrero shaft, the outflow at west portal was about 7,300 g.p.m.

East of Potrero shaft the rock encountered has been a medium hard, blocky, granodiorite containing some soft seams. For three months the source of the water has been largely small seams in which crushed material occurs. During this period the formation has been such that about half the footage advanced has required support. The length of rounds pulled in the main heading face has been about 8 ft.

The pioneer bore parallels the main heading in Potrero east, 75 ft. to the south. In November the advance in the pioneer heading averaged 22 ft. per day which represented a considerable gain over the 15.3 ft. per day average in the main heading; but in the month ending Jan. 15 the main headings were making the better records. If and when required by poor ground in the main heading, the plan is to put through a cross drift from the pioneer bore so as to give access to an additional face on the main tunnel line.

From Cabazon shaft the 8,880-ft. length of tunnel to the east portal has been holed through and lining was started early in December, making use of a gravel plant at the portal which will be used to line the portion of the main tunnel concreted from the Cabazon end.

TUNNEL DRIVING PROGRESS IN HEADINGS BETWEEN CABAZON AND POTRERO SHAFTS SINCE PIONEER BORES WERE STARTED

Period (All in 1936)	Main Heading (ft.)	Pioneer (ft.)
Cabazon		
May	100 [1]	39 [3]
June	30 [4]	210 [4]
July	0 [4]	83 [4]
August	168	271
September	444	520
October	325	356
Total	1,067	1,479
Days elapsed time	170	170
Ft. per day, elapsed time	6.28	8.70
Ft. per month	192	266
Potrero		
June	18	155 [2]
July	381	569
August	638	888
September	723	774
October	596	636
Total	2,356	3,022
Days elapsed time	132	132
Ft. per day, elapsed time	17.85	22.89
Ft. per month	548	703
Combined		
May	100	39
June	48	365
July	381	652
August	806	1,159
September	1,167	1,294
October	921	992
Total	3,423	4,501
Days elapsed time	302	302
Average advance per heading per day (elapsed time)	11.33	14.90
Average advance per month per heading	348	457

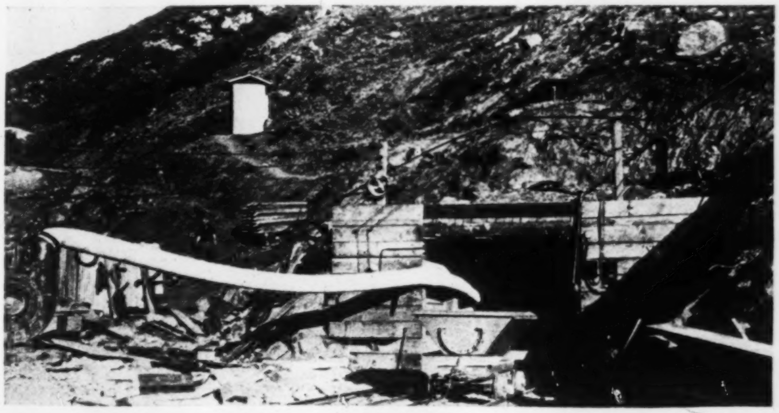
[1] Installing pumps June 3 to August 3.
[2] Started June 22.
[3] Started May 15.
[4] Work in both headings shut down while additional pumps were being installed.

Cabazon west

The heading from Cabazon west on Jan. 15 had been advanced 11,711 ft. and then was in hard gneiss and granodiorite. About 40 per cent requires timbering. The inflow into this main heading amounts to 11,500 g.p.m., but it has been decreasing somewhat in recent months. Although the main heading is driven on a uniform downgrade (0.00065), thus requiring sumps at frequent intervals to keep the heading unwatered, a more convenient plan is possible in the pioneer bore. This is driven on a saw-tooth grade, that is, a downgrade is made relatively steep for a few hundred feet to a level somewhat below grade and then a slight upgrade is followed for a long distance, thus causing the water to drain back from the heading by gravity. When the heading has risen somewhat above grade line the gradient reverse plan is repeated. Small "sponge" pumps are kept within about 100 ft. of the heading. These deliver to main sumps which are put in at about 500-ft. intervals or as the inflowing water quantity requires.

On Jan. 15 the pioneer bore from Cabazon was 59 ft. ahead of the main tunnel heading and the Potrero pioneer was 122 ft. in advance of the main heading. Both pioneers have been found to provide valuable advance information as

FIG. 3—PORTAL OF LAWRENCE ADIT, the 25 per cent incline which is to tap the main line of San Jacinto tunnel.



to the formation and quantity of water to be encountered in the main heading. At Cabazon, as at Potrero shaft, it has been found possible to make considerably better progress in the pioneer than in the main heading. District officials are confident that in time there will be a sufficient gain in the pioneer headings to permit of making crosscuts and starting new faces on the main tunnel line. Combining the rate of progress in the two pioneer headings, the advance has been 32 per cent greater than in the main headings. The relative progress in the headings during the fall is listed in the accompanying table.

Lawrence adit

Lawrence adit is to have a total length of 5,652 ft. as measured on the 25 per cent incline. Up to Jan. 15, 2,261 ft. had been driven. The average rate of progress in this heading is 10-ft. per day. The inflow of water into the incline, all in the last 1,000 ft. driven, was 440 g.p.m. and this was being handled by a pump lift built 1,600 ft. down the incline from the portal. The pump capacity at this station is 2,000 g.p.m. provided by pumps taken from Potrero shaft. As additional pump capacity is required other stations will be put in at lower levels. These, likewise, are to be equipped with pumps removed from the Potrero installation.

Mucking on the incline has been the major difficulty in advancing Lawrence adit. As first mucking was done with a "slusher," adapted from coal mining practice, which was not wholly satisfactory. Use of this was discontinued and several expedients, none of them highly successful, were tried. Equipment still in process of development is a rebuilt Conway mucking machine in which the dipper has been reconstructed to elevate muck to a high level belt (about 9 ft. above the rail). Because of the 25 per cent incline, the belt in the standard machine is too steep. In the rebuilt machine the belt parallel to the track has about the maximum grade on which muck can be moved. One detail of this device which has not yet been fully developed is the method of advancing the machine into the muck pile and withdrawing it therefrom. As the rig was operated at first, when the machine was to be drawn back from the muck pile it was moved by the main cable but to ease it down into the muck without movement of the main cable, a four-part tackle between the main line and the machine was employed.

The rock traversed in the adit has been a blocky granodiorite containing some quartz. Customary requirement has been 28 to 30 holes in the face for pulling 5-ft. rounds. Thus far timbering has been required in about 30 per cent of the adit. For the most part it has been sufficient to put in timber frames with spiling in the roof only.

San Jactino tunnel is being driven by force account by the Metropolitan Water District of Southern California. F. E. Weymouth, general manager and chief engineer. J. L. Burkholder is assistant general manager in charge of construction, J. B. Bond is division engineer, divisions 5 and 6, and B. C. Leadbetter is general superintendent at San Jacinto tunnel.

One Hundred Million To Pay for Obsolescence

Outgrown road facilities in Pennsylvania forecast the reconstruction task that faces all states—New requirements to meet new conditions introduced by motor vehicles call for new highway systems.

By Albert J. Bedard

Former District Construction Engineer, Pennsylvania Department of Highways, Harrisburg, Pa.

THE MEDICAL WRITER *often uses a case history to present a general lesson in diagnosis and medication. Substantially this method is adopted by the writer of the article that follows. The road ailments of Pennsylvania are common to all states; they have developed in all states from the same causes and the cure is the same — a resysteming of the roads. Do not think that is not coming! It looms directly ahead and involves a road construction program greater than any that the past has witnessed.*

—EDITOR.

OBSOLESCENCE is overtaking the highways. To meet its ravages in Pennsylvania 1,000 miles of new roads should be constructed at a cost of $100,000,000. Let this fact bear in on our minds for a moment!

In its life of almost a quarter of a century the Pennsylvania highway system has improved its physical qualifications to serve transport comparably with such improvement anywhere. Yet the problem that faces the state highway administration today is the reconstruction of its main roads. The same problem faces or will in time face all states. How has it come about? An account of Pennsylvania road and traffic history gives the answer and also answers the more important question why this nation cannot stop roadbuilding.

Design grows up

Pennsylvania now has a state highway system of about 36,000 miles of roads and streets. The system had its inception with the Sproul Act in 1913 which provided for the adoption by the commonwealth of some 11,000 miles of roads connecting county seats. Subsequent acts of the legislature have added to the system until it now includes about 45 per cent of all the public roads outside of cities, boroughs and incorporated towns, and in cities and boroughs all streets which are continuations of state highways. The roads are of every character from the unimproved earth road carrying less than 25 vehicles per day to the superhighway carrying in excess of 20,000 vehicles per day.

Early road improvements accorded with the needs of the day. The urge was to provide an all-weather surface at the least cost and with the minimum deviation from established rights-of-way. Emphasis was placed on the mileage that could be completed in a season with the funds available. For that period the standards of design were adequate. Curves were eased for safe operation at 20 miles per hour and it was not long before improvement included the banking or superelevating of curves. Gradually as traffic became more dense and motor vehicles developed greater speeds, the standards of construction were improved. Curves of longer radius were used; the amount of superelevation was increased and superelevation was more commonly used; grades were given closer study, and some attention was given to safe sight distances.

Early in 1920 it was felt that a real effort should be made to limit curves to a minimum radius (600 ft.) but many exceptions were permitted so as to reduce cost or because of right-of-way difficulties. Locations still followed existing roads except for short relocations for the correction of very bad alignment or grades. Every small community sought to have the highway routed over its main street and property owners wanted the improved roads near their buildings. All these influences tended to maintain the devious courses of the main highways. At that time traffic was largely local; very little originated from points more than 30 miles away and local interests were given primary consideration because the roads were primarily for local service.

Late in 1920 and early in 1930 many of the main roads first constructed, especially those which were particularly hazardous, were reconstructed. More study was then given to location and a marked advance was made in the standards of construction. Extensive relocations were made to correct the alignment, grades and directness of course. Occasional attempts were made to avoid villages and boroughs which were not in the line of direction. Long tangents and sweeping curves of a minimum radius of 1,500 ft. were sought and few exceptions were made. Three-lane and four-lane highways were constructed in the most congested areas. Local opposition of property owners was given minor consideration.

The highways constructed during this period did much to ease congestion, reduce hazards and increase the safe operating speed of traffic. The viewpoint of the problem had broadened considerably but the influence of small communities, large villages and small boroughs, was still given major consideration. The local traffic derived from communities having a population of 2,000 or more was still a considerable portion of the total and it was believed that the location should be chosen that would serve this traffic.

Traffic changes character

Meanwhile there had been changes in highway traffic. The motor vehicle improved so that it is now possible to travel safely at greater speed providing a highway is available which has suitable alignment, grades and sight distance. The law permitted maximum speeds of 30 miles per hour in 1920; it now permits maximum speeds of 40 m.p.h., and the limit will probably be increased to 45 or 50 m.p.h. in the near future. These greater speeds and a connected system of improved highways have increased the use of the automobile for trips of more than 100 miles and produced a greater proportion of through traffic on the main highways.

In 1920 engineers and economists generally agreed that 30 miles was the economic limit of truck haul beyond which only a small number of articles having a high value and small bulk could be economically transported. Today the motor truck hauls goods across the entire breadth of the state of Pennsylvania. Such a high-bulk, low-value product as coal is hauled by truck 100 miles and occasionally farther. Scheduled truck service has been established and many manufacturers transport their product or raw materials 100 miles in their own equipment. Long-distance bus service has been inaugurated.

This increase in the length of the economic haul of goods and passengers has increased the amount of through or foreign traffic which is routed through small villages and boroughs located on main highways, and is changing the opinion of these small communities concerning the desirability of being directly on the road.

When the maximum traffic expected was 2,000 to 3,000 vehicles a day, the advantages of having a state highway routed through a village or borough were obvious. This volume of traffic did not create such congestion that it interfered with the transaction of local business and local business profited from trade with transients. In addition the community had its main street constructed and maintained by the state government.

Local sentiment toward foreign traffic becomes entirely different when the volume exceeds 3,000 vehicles per day and grows to as much as 10,000 vehicles per day. In these cases the village or borough is subjected to a constant procession of fast moving traffic among which are heavy rumbling trucks. Pedestrians have difficulty in crossing the street, children are endangered from the passing vehicles and local business is transacted under difficulties. Because of this, local sentiment is beginning to favor bypassing through traffic and within a few years local influences should be practically eliminated from consideration in the location of a highway carrying more than 80 per cent of through traffic.

To provide suitable highways for through-traffic routes carrying heavy traffic by the modification of existing roads will in many cases be more expensive than to provide additional highways on new locations. The existing roads have not been constructed to the standards required for traffic of this character. Curves are too sharp, grades too steep, sight distances and the right-of-way widths are inadequate. It will not be practicable to correct these features and widen the highway to three or four lanes without incurring prohibitive right-of-way and damage costs.

A new system needed

An entire new system designed primarily for through traffic is required to relieve the congestion now existing on most of the through-traffic highways; to route traffic away from thickly populated areas where it now constitutes a hazard and a nuisance and to insure directness of course and safety of operation.

A system of less than 2,000 miles of highways will adequately meet the present needs for through traffic and the present system could be utilized to a considerable extent in the development of the new one, thus reducing the actual mileage of new highways required.

The construction of 1,000 miles of new highways would probably solve the problem for the present generation. The estimated cost is $100,000 per mile or a total cost of $100,000,000. This expenditure spread over a period of five to ten years is not impossible of attainment in Pennsylvania.

Concrete Slabs Under Concentrated Loads

A TEST PROGRAM carried out at Iowa State College as reported in Bulletin 126 Iowa Engineering Experiment Station, by M. G. Spangler, throws some new light on the distribution of shearing stresses in concrete floor slabs under concentrated loads. Previous work on the subject has dealt only with loads placed near the transverse centerline of the slab. The Iowa investigation studied the effective width to be used in concrete floor slab design by placing the concentrated load in a position to produce maximum shearing stresses, namely at a support. Begun in 1925, the studies have been expanded until data are now available on 20 rectangular slabs ranging in thickness from $2\frac{1}{2}$ to $6\frac{1}{2}$ in., in width from 5 to $7\frac{1}{2}$ ft. and in span from $3\frac{1}{2}$ to 10 ft. The data have been used in empirical working formulas for obtaining the effective width for shearing stresses in slabs under single concentrated loads, dual-tired wheel loads and the front wheels and opposite rear wheels of single trucks or passing trucks.

Among the conclusions in the report are the following:

(1) The effective width for maximum shearing stresses is independent of the span of the slab.

(2) The effective width for maximum shearing stresses varies with the thickness of the slab when the load is placed at a distance equal to or greater than $3.25\sqrt{t}$ from a free edge of the slab, and it may be expressed by the formula $e = 5\sqrt{t}$, where t is the thickness of the slab, and t and e are expressed in feet.

(3) When the load is placed closer to a free edge than in (2) above, the effective width $e = 1.75\sqrt{t} + d$ where d is the distance from the free edge in feet.

(4) The effective width for maximum shearing stresses is independent of the width of the load up to a width of $4\frac{1}{2}$ inches.

A. G. C. Discusses Current Problems at 18th Annual Convention

Labor relations, insurance, day labor, legislation and other live topics considered at four-day meeting of contractors at San Antonio.

Engineering News-Record Staff Report

SOME 500 members of the Associated General Contractors of America, displaying a fighting and determined mood, met for their eighteenth annual convention at San Antonio, Tex., Feb. 15-18, in what proved to be one of the livest and best-attended meetings in the history of the organization. Led by President W. A. Klinger and Managing Director E. J. Harding, the members in convention tackled the many problems confronting the construction industry today. The industry showed a surprising change of attitude toward questions that have been deftly side-stepped in the past. Such topics as labor relations, apprentice training and rising compensation insurance costs were thoroughly discussed for the first time in open meeting.

Gas-tax diversion and day-labor operations—old topics—came in for further vigorous condemnation. In fact, day labor was attacked more bitterly than ever before, especially the WPA system. In contrast, the PWA system of construction by contract procedure received strong praise, particularly at the annual banquet, where Secretary Harold L. Ickes, Public Works Administrator, heard Mr. Klinger damn WPA in no uncertain terms and enthusiastically praise PWA for its attitude toward contractors. Administrator Ickes, in his turn, applauded the contractors for their part in making his program a success. The atmosphere represented a sensational change from that of three years ago, when the Secretary directed sharp criticism at the whole contracting profession.

Little internal squabbling

NOT MUCH TIME and effort were wasted at the convention in the intramural squabbling that so frequently mars contractors' sessions wherever they may be held. Especially noticeable was the lack of old-time bitterness against surety bonding interests, equipment and materials agents and insurance carriers, for at this meeting the contractors and their associates within the industry were bound close together in a fight to protect and to further their common interests.

All through the meeting there was an apparent undercurrent of appreciation of the activities of the officers and the sectional headquarters staff. An analysis of these activities reveals them to be no greater nor of any more importance than similar work in the past, but an outside observer could not but feel that perhaps for the first time the full significance of the value of the efforts of the association officers and staff was realized by the member body. This realization culminated in a decision to raise the membership dues to finance the association's activities more effectively.

The annual report of the managing director showed that the A. G. C. is at its peak in membership and strength. Present membership is 2,539, divided among 119 chapters and branches. A loss last year of some 300 members, mostly those who flocked to the association's banner during the code days, has been more than offset by the addition of 530 new members. Just as soon as finances permit, the organization plans to place four or five membership secretaries in the field to assist the local chapters and branches. At present but one staff member is devoting any time at all to membership activities.

Balk at stand on labor

REPRESENTING all classes of general contractors from all parts of the country, the A. G. C. has in the past consistently avoided even a discussion of labor relations and the contractor's labor problems. During the San Antonio meeting, however, the subject came up repeatedly and resulted in much controversy. It was revealed that several local chapters representing highway and heavy contractors, especially in the Northwest, have made agreements with organized labor in the name of the chapter. This action was both praised and condemned from the floor, and advocates of the plan to recognize labor organizations, other than building trades, pointed out that such recognition and resulting agreements are necessary to stop the invasion of engineering construction by building trades unions and to stabilize labor rates for a definite period ahead. Opponents of the plan, especially those contractors working on a national scale, emphatically contended that local chapter agreements were made solely to keep outside contractors from taking work in the territory of the local chapters.

A resolution presented for consideration would have given tacit, but not direct, approval to such agreements, but in the storm of protest that arose the resolution was tabled and not passed. From the discussion it was apparent that the labor situation is considered not ready for definite action at this time. However, no action was taken that prevents local chapters from making further agreements.

Other controversial subjects fared better. For the first time the A. G. C. agreed to support actively the formation of accident prevention codes. Heretofore it has held that education and voluntary accident prevention work is not only sufficient but more desirable.

The convention endorsed the plan promoted in Washington to set up model and uniform regulations for voluntary apprenticeship training to be carried out by the various states. The local chapters were urged to push such legislation in their states.

Other resolutions as passed endorsed the PWA contract system; condemned certain subcontractor agreements with organized labor whereby building trades would work only for subcontractors, thus prohibiting general contractors from doing certain work; urged advance planning for public works; urged continuation of federal aid for highways; and condemned the practice of charging bidders for plans and specifications without a refund for their return. Resolutions were also passed that asked for changes in PWA labor regulations so that contractors might be allowed to move their skilled and intermediate-grade workmen from one job to another. Another resolution recognized the need for diverting highway revenue funds to city street work in certain cases but condemned gas-tax diversion in general. Amendment of the 1936 Revenue Act was advocated to permit deductions for capital expenditures for new plant and machinery, for replacement or betterment of physical plant and for payment of debts made for such purposes.

Geo. B. Walbridge, chairman of the legislative committee, reviewed the legislation affecting construction passed by the last Congress, and pointed out some of the undesirable bills already before the present Congress. Particular emphasis was laid upon the O'Mahoney bill, which seeks to license and regulate all business having to do with interstate commerce. Mr. Walbridge declared that watching national legislation, fighting undesirable proposals and helping out on favorable bills, is the most important function performed by the national organization.

Many excellent addresses

The convention heard many excellent talks by outsiders, some of the speakers being outstanding authorities. Secretary Ickes, besides commending the contractors for their part in the PWA program, outlined the success of the PWA in providing employment and in aiding recovery and at the same time providing the various communities with worthwhile public works at a reasonable cost.

John C. Page, Commissioner of Reclamation, spoke on the Natural Resources Committee water conservation recommendations, and also emphasized the Reclamation Bureau's favorable stand on the use of contractors. Thomas H. MacDonald, Chief, U. S. Bureau of Public Roads, reviewed the emergency program of roadbuilding, looked ahead at the future course of highway planning and construction, and pointed out the benefits of labor regulations as promulgated by his bureau. He announced to grateful listeners the removal of restrictions that held contractors to use of skilled and intermediate labor supplied by the federal employment service; contractors may now obtain these two classes of labor whenever they may desire. The wage stipulations and necessity of securing common labor through the employment service still stand.

W. P. Napier, San Antonio banker, deplored the hesitancy of banks in extending credit for construction, and pointed out the fallacy of investing solely in government bonds that can be paid for only out of taxation. He declared that capital must recognize its responsibility to provide work for labor. N. Max Dunning, of the Federal Procurement Division, reviewed the activities and purposes of that division.

The retrospective rating plan of compensation insurance, whereby the contractor participates fully in savings resulting from favorable accident records, was outlined by J. W. Randall, vice-president of the Travelers Insurance Co.

The seven A. G. C. chapters in Texas combined to act as host to the convention, and arranged a program of entertainment and sight-seeing never before equalled in the history of the organization. The usual three-day convention was extended to four days to allow free afternoons and evenings, and the local committee took care of every free moment the delegates had from the meetings. No detail was overlooked, even to the providing of free bus service back to town from the race track for the benefit of those unfortunate contractors who made ill-judged bids on unfamiliar projects.

W. A. Klinger, of Sioux City, Iowa, was re-elected president for the coming year. E. P. Palmer, of New York, was again elected vice-president at large.

Piling Casting Method Saves Forms and Storage Space

Some 900 tapered precast concrete piles about 25 ft. long were required in the foundations of an extension to the municipal power plant at Kansas City, Kan., located on the bank of the Missouri River. By casting the piles in layers and in two operations, the first involving the odd numbered piles, the second the even numbered piles, forming was reduced to a minimum and only a small ground area was required for the work. As shown in the illustrations, four tiers or layers of piles were laid up in one stack.

Only side forms are required. These were made of 2-in. lumber assembled so that the space between piles being cast was exactly that required for another pile. After the first half of the piles in a tier were cast, the forms remained in place for 24 hr. They were then removed and the sides of the piles well brushed with parafine oil to eliminate bond when the adjacent pile is cast. Steel reinforcing was set and the intervening spaces filled with concrete making a solid tier of piles. After 24 hours, a layer of tar paper was placed over the first tier of piles, the forms reset, and the same sequence of operations repeated for the next tier. By casting several groups simultaneously, the job was systematized into a continuous manufacturing process.

The concrete mix consisted of 7 sacks of cement, 1,300 lb. of sand, and 1,900 lb. of rock. A 3- to 3½-in. slump concrete was produced. Internal vibrators aided in placing the concrete. The average crushing strength obtained was 3,750 lb. per sq.in. in 7 days, 4,400 lb. in 14 days, and 4,600 lb. in 21 days. Driving was permitted when a strength of 4,000 lb. per sq.in. was attained.

Direction—

The piles were cast by F. T. Leeder, Sioux City, Iowa. The contract for the work was awarded to E. A. Whitney & Sons, Inc. and Jones-Hettelsater Construction Co., Kansas City, Mo. at a price of $1.73 per lineal foot in place. Burns & McDonnell Engineering Co., Kansas City, Mo., is in charge of the work.

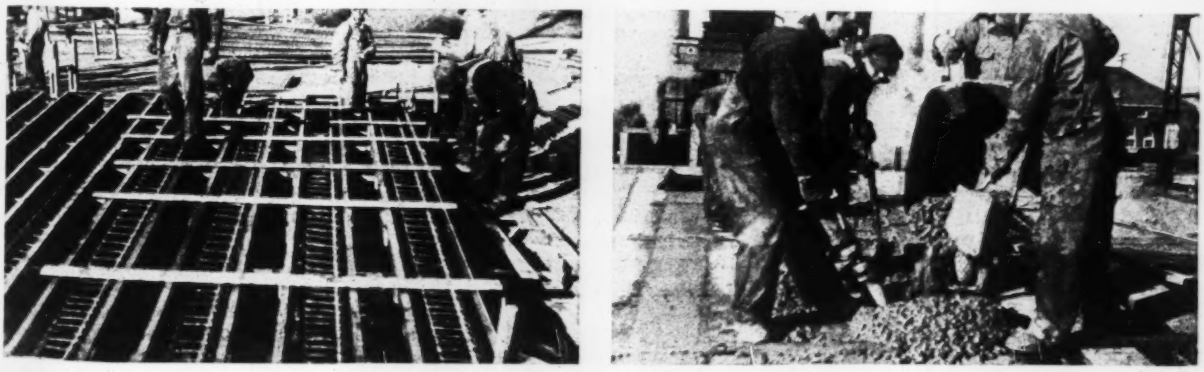


FIG. 1—TWO CASTING OPERATIONS produce a tier of concrete piles. Left, forms and steel in place for first pour. Right, filling intervening spaces between piles of first pour which serve as forms.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

Pipe Flow Analysis

THE MECHANICS OF TURBULENT FLOW—By Boris A. Bakhmeteff. 101 pp. Published by Princeton University Press, Princeton, N. J. Price $3.50.

ADVANCES IN HYDRODYNAMIC RESEARCH abroad have provided much information that can be applied toward more precise solution of hydraulic flow problems. Since progress has been so rapid and publication of results has been confined to German and other foreign papers, efforts were made at Princeton University to bring these developments to American engineers and students through a series of four lectures. The last lecture, "Applied Hydrodynamics" by Professor Bakhmeteff of Columbia University, was a summary of recent advances and their practical applications, and it provided the foundation for this book. The experimental evidence and mathematical analysis presented refer exclusively to pipe-flow phenomena, but the author points out that the reasoning is quite general and should apply to all cases of flow.

Flow Meter Handbook

BROWN FLOW METER ENGINEERING HANDBOOK—Compiled by Louis Gess and J. O. Feldmark. 162 pp. Published by the Brown Instrument Co., Philadelphia, Pa. Price $2.

THE OBJECT of this practical handbook is to familiarize the reader with the correct design, installation and operation of flow meters. For this purpose a complete outline is given of the essential features common to all types of such meters. Particular attention is paid to a detailed description of the methods used in the correct design of the differential pressure producing element, known as the thin plate orifice. Numerous examples are given as to how to compute the orifice sizes for various fluids.

Railway Maintenance in Britain

RAILWAY MAINTENANCE PROBLEMS—By H. A. Hull, formerly district engineer, Northampton: L. & N. W. Ry. and L., M. & S. Ry., 1918-1933. Cloth: 5¾ x 8½ in.; pp. 75; 51 line cuts. Published by *The Railway Gazette*, Westminster, London, England. Price 5s.

SINCE THIS LITTLE BOOK covers in less than 50 pages of text (in large type) such a wide range as earthwork, drainage, foundations, substructures, superstructures, track and buildings it is obvious that its treatment of the several subjects must be very brief. As a matter of fact it is composed largely of descriptions of specific examples of maintenance and repair or emergency work that have come within the author's experience. Among the most interesting matters are slides in cuts and fills, which the author considers can generally be controlled by loading the toe as soon as signs of trouble become apparent. Most of the slides noted were in open country. There are interesting notes also on repairs to masonry bridges and to different types of bridge floors. For the American reader there are some difficulties arising from differences between American and English track construction and technical terminology.

Studies in Finance

MUNICIPAL BONDS—A CENTURY OF EXPERIENCE—By A. M. Hillhouse. 579 pp. Published by Prentice-Hall, Inc., New York. Price $5.00.

PUBLIC FINANCE—By Alfred G. Buehler. 632 pp. Published by McGraw-Hill Book Co., Inc., New York and London. Price $4.00.

THE RECENT economic depression revealed in striking fashion the importance of sound governmental financing. As a result, local, state and other agencies are either revamping or preparing to revise their financial practice. To properly appraise the merit of changes in policy requires specialized knowledge and background in the field of finance. Toward the realization of this end, two books have recently become available.

The first, "Municipal Bonds," is a critical history of the finances and debts of cities, counties, townships and other local governments, both in this country and in Canada. Going back to 1830 it records a century of experience in borrowing, laying particular stress on the faults and weaknesses of debt administration that have occurred in the past. The author states that he has made "a study in pathology," and justifies this approach on the principle that by revealing the mistakes of the past those of the present can be corrected and similar mistakes can be avoided in the future. The book is interestingly written and contains many practical suggestions for strengthening municipal financial practice.

The book, "Public Finance," is written for the reader who desires an introduction to the principles and problems of government financing. It traces the development of fiscal organization and then discusses federal, state and local expenditures. Various forms of taxation, their limitations and complexity, are treated in considerable detail. Chapters on methods and practices of borrowing, principles of debt payment and the economic significance of government debts, completes this well-rounded treatise on the changing and intricate field of public finance.

Sewage Disposal

SEWERAGE AND SEWAGE TREATMENT—By W. A. Hardenbergh. 396 pp. Published by International Textbook Co. Scranton, Pa. Price $3.50.

THE ENGINEER who lacks specialized training in sanitary engineering will find this book highly useful in providing a comprehensive background of sewage disposal practice. It has been written with a view of supplying a balanced and basic treatment of the subject, to serve as a foundation for more detailed study.

The first half of the book deals with the hydraulics, design, construction and maintenance of sewer systems. Typical examples of design are given and worked out to illustrate the application of principles and formulas. Data and reference tables also are included.

The second section is a simple but thorough discussion of sewage treatment processes, with illustrations of modern equipment and plant layout. The author has included a number of simple problems to familiarize the reader with logical methods of design; of particular interest is an example setting forth the procedure in designing the unit for a small (750 persons) institutional treatment plant.

Miscellaneous Notes on Booklets and Reprints

HOW MILWAUKEE STOPS ACCIDENTS is the subject of a pamphlet published by the Accident Prevention Conference, U. S. Department of Commerce, Washington, D. C.

INDUSTRIAL PROPERTY RETIREMENT is discussed in a report entitled "Statistical Analyses of Industrial Property Retirement" published as Bulletin No. 125, Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.

SCALE AND CORROSION CONTROL by the application of organic chemicals to water is discussed in a booklet issued free by D. W. Haering & Co., Inc., 3408 West Monroe St., Chicago, Ill. This booklet defines the various chemical theories employed in water conditioning and includes a history of the subject along with an explanation of control methods employed at the present.

Welding Lessons, a mimeographed booklet used in the school for arc welding operators conducted by the Lincoln Electric Co., Cleveland, may be purchased for 50 cents.

Road School Papers presented at the 22d annual road school, held at Purdue University, Jan. 20-24, 1936, have been published as Extension Series No. 37, Engineering Extension Department, Purdue University, Lafayette, Ind.

Construction Data of value to builders, statisticians and others are given in a pamphlet entitled "Construction Data," by Arthur W. Varian. The book can be obtained from the Engineers Bookshop, 168 E. 46th St., New York. Price 50c.

Highway Engineering papers presented at the 23d annual conference on highway engineering, held at the University of Illinois, Feb. 26-28, 1936, have been published by the Engineering Experiment Station of the University as Circular No. 27. Price, 50c.

Epidemic Amebic Dysentery—the Chicago outbreak of 1933, is the subject of Bulletin No. 166, National Institute of Health, Public Health Service, Washington, D. C. Copies may be obtained from the Superintendent of Documents, Washington, D. C. Price, 20c.

Highway Accident Prevention is the subject of a pamphlet entitled "Creating Safer Communities," published by the New York State Traffic Commission in collaboration with the National Bureau of Casualty and Surety Underwriters. Copies may be obtained from the Commission's office in Albany.

Water Power in Norway is the subject of a pamphlet printed by the Norwegian Society of Civil Engineers for distribution at the recent Third World Power Conference in Washington. Copies may be obtained through the American National Committee, World Power Conference, Interior Building, Washington, D. C.

Loss of head in cast iron tees, involving all possible combinations of flows, was studied at the Texas Engineering Experiment Station. Among the conclusions, as reported in Bulletin No. 41, it was revealed that the loss of head is a function of the percent of water diverted at right angles in the tee. An interesting feature of the report is the photographs showing actual lines of flow in the tees; these were made visible by producing hydrogen and oxygen bubbles in the fluid stream electrolytically. The bulletin can be obtained free by addressing F. E. Giesecke, Director, College Station, Tex.

Tax Rates upon property for 1936 in 259 cities of the United States and Canada are shown in tabulated form in a monograph prepared by Rosina Mohaupt and issued by the Detroit (Mich.) Bureau of Governmental Research, Inc. This is the fifteenth annual compilation of these data.

Digestion of Garbage with sewage sludge was studied by Babbitt, Leland and Whitley at the University of Illinois. The results of this investigation are given in Bulletin No. 287 issued by the Engineering Experiment Station at Urbana, Ill. For a short time copies will be available for free distribution.

Industrial Wastes in New Jersey is the title of Bulletin 610 issued by the New Jersey Agricultural Experiment Station, New Brunswick, N. J. This booklet describes the methods used in making a study of stream pollution caused by trade waste discharges. Analytical results are given for a number of representative industries.

Research Results in the interests of better building are contained in the annual report of the Building Research Board of the Department of Scientific and Industrial Research of Great Britain. The board corresponds to the U. S. Bureau of Standards in this country and the research work is of comparable scope. Price, 3s. 6d. From His Majesty's Stationery Office, London.

House Building Costs—Three more bulletins from the Purdue Housing Research Project giving costs and structural details have been published. They cover an all-wood house, sponsored by the National Lumber Manufacturers Association, a prefabricated house of General Houses, Inc., and a two-family experimental house erected in a slum district in Indianapolis at a cost of $1,339. The booklets are available only on yearly subscription to Better Homes in America, Purdue University, Lafayette, Ind.

Textile waste treatment information, compiled from previously published material, consultation with experts, and examination of plants now treating textile liquid waste, is summarized in a comprehensive report published by the Textile Foundation, Inc., Commerce Building, Washington, D. C., and sold for $1. Among the subjects dealt with in this 118-page booklet are: textile processes and the nature of the waste produced; reduction of liquid waste within the mill and the recovery of byproducts; the methods used for treating textile waste; the treatment of textile waste in combination with municipal sewage; descriptions and diagrams of plants treating straight industrial waste and waste in combination with sewage. For the use of those who wish to go into more details concerning presentation of the problems, a classified bibliography of 340 references is included.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

THE WELDING AND CUTTING YEARBOOK 1936-37—Edited by C. Helsby, C. W. Hamann and F. J. Samuely. 261 pp. Published by The Temsbank Publishing Co., Ltd., London, S.W. 1. Price 5s.

THE HYDRO-ELECTRIC PRACTICE IN INDIA—By B. C. Chatterjee. 1,168 pp. (2 vols.). Published by Shiva Narayan Chatterjee, Benares City. Price 50 rupees.

TRAFIKTEKNIK—By H. N. Pallin. 446 pp. Published by Alfred Bonniers, Stockholm.

END OF TRACK—Reminiscences of James H. Kyner as told to Hawthorne Daniel. 277 pp. Published by the Caxton Printers, Ltd., Caldwell, Idaho. Price $3.00.

DEEP DIVING AND SUBMARINE OPERATIONS—Compiled and edited by Robert H. Davis, 510 pp. Published by The Saint Catherine Press, London. Price 18s.

ANALYSIS OF ENGINEERING STRUCTURES—By A. J. Sutton Pippard and J. F. Baker. 554 pp. Published by Longmans, Green & Company, London and New York. Price $9.00.

VEREINIGUNG FUR LUFTFAHRTFORSCHUNG—JAHRBUCH 1935—341 pp. Published by R. Oldenbourg, Munich, Germany. Price 6 RM.

AIR CONDITIONING-INSULATION—By J. Ralph Dalzell and James McKinney. 301 pp. Published by the American Technical Society, Chicago. Price $2.50.

WATER TREATMENT AND PURIFICATION—By William J. Ryan. 242 pp. Published by McGraw-Hill Book Company, Inc. New York. Price $2.50.

◆

Type Interchanged In Letters to the Editor

In a last-minute change in the letters pages of the Feb. 18 issue to get in a letter from J. H. Hawley, director of the U. S. Coast and Geodetic Survey, relating to elevations stamped on benchmarks, two blocks of type were interchanged. As a result the last paragraph and signature of the first letter on p. 274, "Shortage of Engineers," were placed at the end of the third letter on the subject of elevations on benchmarks, and the last paragraph of that letter and the signature were appended to the letter on shortage of engineers. This latter letter was written by Walter E. Brown and the third letter on benchmarks was written by W. W. Studdert. Our apologies to Mr. Brown and Mr. Studdert and to the readers who were confused by the fact that the two letters in question did not appear to read logically. Editors

ENGINEERING NEWS-RECORD
Volume 118, No. 8. Copyright, 1937, by McGraw-Hill Publishing Company, Inc.
EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, N. A. Bowers, W. G. Bowman, W. W. DeBerard, C. S. Hill, H. W. Richardson, E. J. Cleary
Editorial offices at 330 West 42nd Street, New York
February 25, 1937

Fishway Troubles

DIFFERENCES OF OPINION about fishways at Bonneville Dam again have arisen between the fishery interests and the army engineers. The fishery people maintain that part of the temporary cofferdam should be left in the river to aid salmon runs; the army engineers hold that to do so would interfere with the safe and prompt completion of the dam. This present demand continues the record of ever new demands on the part of the fishery interests, demands that to date have run the cost of fishways at Bonneville Dam up to $6,500,000. As nothing definite yet is known as to the practicability of the expensive work already done, reason would seem to dictate that no more expense or delay be incurred until after the next run of salmon has shown to what extent the fears of the fish interests have foundation in fact.

Funds for Maps

A MAPPING PROGRAM calling for the expenditure of $5,000,000 annually over the next twenty years was presented to the Senate by Secretary Ickes on Jan. 28 and was made public last week (*ENR* Feb. 18, p. 280). The Secretary's help in getting federal mapping put on a definite basis will be welcomed by all concerned with maps. His chief contribution is recognition of the fact that to be most productive the mapping program must be on a continuing basis so that the Geological Survey and the Coast and Geodetic Survey can count on a definite annual appropriation and can organize their staffs and work accordingly. Even though the amount recommended—$5,000,000 annually—may not be as large as seems desirable in view of our present lack of adequate maps, it will be much better to get the 20-yr. plan accepted in principle and started on a modest and regular scale than to have to depend on irregular appropriations of uncertain amounts each year.

Road Regulation Confused

WHATEVER LEGAL FOUNDATION there may be for the recent decision of a Southern court that state regulation of road vehicle size and weight is void because "unreasonable" when applied to main roads, it does seem that a court invades legislative territory when it asserts that the legislature's act was not reasonable. We have not heard that the court denied the legislature's power to control road traffic. This latter is the question that courts should settle. We ought to know whether there is any authority that can control the truck train, the convoy and the bus, and that can restrain the road hog and the road destroyer. We ought to be told whether Congress or the state has power to exercise such control, for present-day conditions make regulation imperative if the road is to be kept open and safe for all. If courts will declare in clear words where the power lies, without leaving a no-man's land between state and federal authority, we can then look to the legislatures to do the rest. Otherwise regulation is confused, not helped; selfish monopolizing and damaging of roads is protected, and the citizen is rendered helpless to safeguard his travel rights.

Engineering on the Bench

IN ADDITION to taking upon itself legislative authority the court in the South Carolina case also assumed engineering functions. It declared that "standard pavement—7½ or 8 in. thick at the edges and 6 or 6½ in. thick at the center—is capable of sustaining without injury a wheel-load of 8,000 or 9,000 lbs. and an axle-load of from 16,000 to 18,000 lbs." Specifically the decision says, "In the light of experience and of scientific knowledge, there is no ground for reasonable difference of opinion as to the gross load limitation of 20,000 lb. not being necessary for the protection of such roads themselves, and there is even less justification for the requirement that the tractor-semi-trailer combination be counted one unit for the purpose of computing gross load." It asserts that there is less danger to traffic from the standard trucks of interstate commerce than from smaller trucks, and that there is not enough advantage in a 90 over a 96-in. width to justify the exclusion of the wider vehicles from the main highways. It is a novelty to see a court make engineering and traffic safety decisions. Such excursions into fields outside the judicial sphere hardly contribute toward increasing the layman's respect for courts.

Adventuring for Water

DUE EAST OF SAN FRANCISCO Mt. Lyell marks the crest of the Sierra Nevada range. With its height of 13,000 ft. it forms a point in the watershed that divides the supply areas of San Francisco and Los Angeles, since the latter city's intakes have been extended northward until those of the Mono Basin project, now under construction, are more than 360 mi. north of Los Angeles. It has been an adventurous undertaking, this extension of what in the beginning was the Owens Valley Aqueduct. The Mono supply is necessary to provide sources equal to the full capacity of the Aqueduct, though power is also a potent argument, since the Mono water will not only have a power drop in falling down to Owens Valley but will all pass through existing power plants on which the total head is 2,348 ft. Going to remote regions, hundreds of miles from the community served, the Mono extension instances strikingly the present-day trend to go to distant sources for city water supplies.

The Fourth Dimension

IN BUILDING MONO, which happens to be a force-account rather than a contract job, the influence of personal management on large and complicated enterprises is revealed in an unusual way. The "chief," that is to say, H. A. Van Norman, chief engineer and general manager of the Los Angeles Bureau of Water, has spent a lifetime on the job and knows his men intimately. Many of them owe a large part of their training and advancement to the personal interest he takes in their affairs. He enjoys the absolute loyalty of a large and capable organization, and while he never hesitates to bring in consultants when they are needed the whole organization feels that essentially the work is the expression of his personal judgment, skill and strength of organization. The influence that knits the working body of men into true organization is the often undervalued fourth dimension in construction—something even more important than working plan, plant layout, time schedules and payment plans. Largely because of it, the uncertain operation of driving a long tunnel through the very throat of a volcanic crater has gone forward with confidence, economy and dispatch.

Sounding to Mud

Some recent experiences recall the uncertainty that attaches to sounding in water with soft bottom, an uncertainty often noticed in the past. The method used for making the soundings leaves it doubtful just what point represents the bottom of the water, as the lead goes to different depths depending on the consistency of the mud. The matter is more important in measuring dredged depths as a basis for contract estimates than in measuring navigation depths, though essentially the same matter is at issue in both cases. A disk attached to the sounding lead is helpful, but again its effect depends on the size of the disk in relation to the weight of the sounding lead, as well as on the consistency of the mud. While the subject is probably not ready for standardization of procedure, consideration of the factors involved should be worth while. In the meantime it is well in writing dredging specifications to define the method of sounding to be used, so that disputes will be forestalled.

Stick to Your Knitting

Contractors in session at the A.R.B.A. convention in New Orleans a few weeks ago presented the incongruous spectacle of thoroughly damning the invasion of their business by day-labor operations and then enthusiastically considering their own invasion of the equally well-established insurance business. According to delegates from the Michigan Road Builders Association plans are well under way in that state to set up a cooperative compensation insurance company, with an eye to the bonding business as well at some future date. If the plan were solely for local operation it would be of lesser significance, but there is prospect of attempts to make the insurance business nationwide as fast as branch offices can be set up.

Two general reasons are given by the contractors for invading the insurance field, both of them fallacious. First, they claim, public agencies enjoy preferential rates or else are not required to take out compensation insurance at all, which favors day-labor work and places contractors at a financial disadvantage. Next, they argue, compensation insurance is a lucrative business, and the only way to beat the present high rates is to go into the business and collect large savings as dividends. It was asserted that premium rates include a 40-per cent profit and "loading" charge.

If compensation insurance laws favor governmental day-labor operations the obvious remedy is to change the laws. Contractors are not without legislative influence, and if backed by labor's demand for worker protection on force-account operations they could stir up enough fuss to bring results.

But the more important contention is that contractors could reduce their insurance costs through a cooperative company. In the first place, it is well known that compensation insurance is not a highly lucrative business. Establishment of reserves, cost of operation and other carrying charges necessitate a loading of rates beyond requirements to meet actual losses. There is a far more effective way for contractors to reduce their insurance rates than to step into a business they know nothing about—*Reduce accidents and keep proper payroll records.*

Keeping down accident losses is the most direct way to cut insurance costs, for rates after all are based on loss experience. Smart contractors realize they are entitled to credit rating if they can show favorable accident records. The same opportunity is open to all, but only the real businessmen in contracting realize it.

Ignorance on the part of contractors as to how insurance premium rates are assessed is responsible for much of the high insurance cost. Rates are established by a central rating bureau, based upon the loss experience of many classifications of work. Lacking specific knowledge as to exact distribution of payrolls comparable with insurance classifications, the carriers have the right to assess the entire payroll against the highest-rate classification of work performed on the job. How simple it is to properly keep payroll records so as to enjoy correct rating assessments, yet how few contractors realize this or take the trouble to do it!

Contractors in the insurance business would be babes in the woods. It is a hazardous business, and requires a business sense and experience entirely foreign to that of the contractor. He has no more excuse for going into the insurance business than he has for manufacturing his own cement or making his own road oils. Stick to your own knitting, and leave the insurance business to insurance men!

Food or Fuel?

A recent committee report of the American Society of Civil Engineers on the present status of refuse disposal practice, reveals that hog-feeding and incineration are the two methods of disposal receiving widest approval. Without debating the respective merits of either method, it should be noted that in both cases emphasis is placed on the recovery of by-product value—food or fuel—from an otherwise useless and troublesome accompaniment to urban civilization.

Present high prices of pork and corn put a special premium on garbage as food for hogs. St. Louis, taking advantage of this situation, since last November has been retailing garbage (which otherwise would be ground and discharged into sewers) to farmers at $1.00 a ton; these sales not only net the city about $75 a day extra revenue but reduce the load and operating costs at the central grinding station.

Municipal incinerators designed to use refuse as a fuel for steam generation have been slow in development, although Atlanta has for many years found this scheme a profitable source of revenue. Last year, however, gave a marked impetus to waste heat utilization at incinerators, and at least four cities have either begun operation or are constructing such installations. At Providence, for instance, the new incinerator will produce sufficient electric power to operate the sewage disposal plant.

It has long been the boast of Chicago meat packers that they use everything but the "squeal." Judging from present trends municipal officials might claim that in refuse disposal they use everything but the odor.

CURRENT NEWS

Power Sale Plan For Bonneville

Proposed bill gives complete control over power to an administrator, leaves navigation to U. S. Engineers

Conclusions reached by the Ickes power policy committee in regard to the disposition of surplus power from the Bonneville project on the Columbia River were revealed Feb. 19 by the introduction of a bill intended to give effect to the committee's recommendations. The bill was introduced by Representative Smith of Washington after a White House conference at which the committee's report was discussed before the Congressional delegation representing the states affected.

Program provisional

The new solution to the Bonneville marketing problem is set up on a provisional basis, subject to change when a more permanent set-up is devised for Bonneville and other projects in the Columbia River basin. It proposes that the completed project shall be operated, maintained, and improved by a Columbia River Administrator to be appointed by the Secretary of the Interior at a salary of $10,000 per year. This administrator shall be advised by a three-man board composed of representatives of the War Department, the Federal Power Commission, and the Department of the Interior. He shall have full authority to install additional generating facilities, operate the plant, contract for the sale and interchange of power, and build, buy, or acquire by condemnation proceedings all necessary distribution facilities. Operation of the navigation locks, however, remains a function of the Corps of Engineers under the direction of the Secretary of War.

In all other respects the new bill follows the pattern set last session, when a number of measures were introduced, but failed of passage. The statutory preference granted to public and co-operative distributors in the allocation of power, with 50 per cent of the firm power reserved until Jan. 1, 1939, to permit the formation of cooperatives and power districts, is continued. Power contracts are to extend for not more than 20 years, including any renewal period, and are to carry provisions for rate revision at intervals of not over five years. Contracts with private purchasers must also contain a provision for cancellation upon five years' notice in the event that the energy so conveyed is needed for public or co-operative distribution.

Rate schedule flexible

The administrator is directed to prepare rate schedules and submit them to the Federal Power Commission for its approval. "Such rate schedules shall be fixed with a view to encouraging the widest possible use of electric energy, having regard to the recovery, upon the basis of the application of such rate schedules to the capacity of the electric facilities of the Bonneville project, of the cost of producing and transmitting such electric energy, including the amortization of the capital investment over a reasonable period of years. In computing the cost . . . there may be allocated to the cost of electric facilities not simply the cost of such facilities, but also such a share of the cost of

(*Continued on page 317*)

PWA Announces Rental On Atlanta Housing

As University Homes, PWA's second housing project in Atlanta, Ga., approached completion, selection of tenants began and it was announced that rentals had been achieved substantially lower than the $7.39 per room per month average at Techwood Homes, the other Atlanta project and the first to be completed in the country.

University Homes will rent for an average of $5.07 a week ($1.69 per room per week) including heat, hot water, and electricity for a three-room house. It was preceded in the Georgia capital by the Techwood Homes project, first on PWA's national program of slum clearance. Other PWA housing projects which have gone into operation include two in Montgomery, Ala., and one in Miami, Fla.

The rental is made up of a $3.72 base dwelling rent, to which $1.35 per week is added to cover the cost of heat, hot water and electricity for lighting, cooking and refrigeration.

Although buildings on the project have not yet been accepted by the Government from the contractor, Administrator Ickes ordered that tenant selection be started. Thus, when buildings are turned over to the Government, tenants will be enabled to move in at once. Tenant selection will be handled from an office established for the purpose.

University Homes consists of 675 living units of 2, 3, 4 and 5 rooms. Rents will vary within the project depending on size, location and desirability, and will range as follows:

UNIT	DWELLING RENT PER WEEK	UTILITY CHARGE PER WEEK
2 rooms	$2.65—$3.10	$1.20
3 "	3.45— 4.00	1.35
4 "	4.20— 5.05	1.50
5 "	5.10— 5.95	1.60

The new homes are apartments and group houses, each with private ground floor entrance. Buildings, which occupy about 25 per cent of the 18-acre site, are surrounded by open landscaped areas. Every dwelling has good exposure, and, being only 2-rooms deep, will also enjoy cross-ventilation.

All buildings of the new project are of fireproof construction. Every effort has been made in the use of materials to facilitate sanitation and cleanliness. Floors

(*Continued on page 316*)

Unusual PWA Grant To Pennsylvania

PWA grants up to 47½ per cent of $42,000,000 program if 75 per cent relief labor is used

Negotiations between the state of Pennsylvania and the Public Works Administration for the financing of a state institutional building program have resulted in an offer by PWA to provide up to $45,000,000, of which $20,000,000 would be a grant and the balance needed a loan at 4% interest. The offer differs from the customary 45% apportionment in that the size of the grant is conditioned upon the requirement that three-quarters of it must be expended for relief labor, with an upper limit to the grant of $20,000,000, without regard to the size of the loan requested or the total cost of the program.

Thus, if Pennsylvania adheres to its proposed $42,000,000 total cost, and agrees to expend at least $15,000,000 for relief labor, it can receive the entire $20,000,000 grant, amounting to slightly more than 47½%.

The special treatment accorded to Pennsylvania is believed to be justified by the fact that the state's constitutional limitation on debt has made it impossible to participate normally in the PWA program undertaken by the state.

The funds will be administered by a general state authority, with Governor Earle as chairman. The major element of the program will be construction work to relieve congestion and eliminate fire hazards in hospitals, prisons, tubercular homes and colleges of the state.

Wessman to Teach Engineering At New York University

Donald E. Wessman, associate professor of structural engineering at Iowa University, has been appointed professor of structural engineering at New York University, the appointment to be effective in September.

In addition to his teaching experience, Professor Wessman has been associated with the Chicago South Park Commission, where he designed and checked bridge structures, and with the firm of Waddell & Hardesty as a consultant engineer on the Arthur Kill bridge at New York, the Mississippi River bridge at Cairo, Ill., the Maumee River suspension bridge at Toledo, and vertical lift bridges at Albany and Troy.

Professor Wessman also served as superintendent of the water department at Rockford, Ill. and for a year was at the Ministry of Railways University in Shanghai, China, teaching structural analysis and design and assisting in the reorganization of the department of civil engineering.

New Contract Awarded for Bayonne Terminal

The city commission of Bayonne, N. J. on Feb. 10 awarded a contract for construction of the port terminal on New York Bay to J. Rich Steers, Inc. and the Standard Dredging Co. on their joint bid of $3,280,000. The bid was divided into $1,170,000 for dredging and $2,110,000 for bulkheading.

The accepted bid was the second lowest; that of the Arthur M. McMullen Co. of New York City was $402,000 lower than that of the successful bidder but was rejected because it was not accompanied by a certified check for 10 per cent of the bid.

A representative of the Pennsylvania Railroad expressed dissatisfaction with the revised contract between the city of Bayonne and Central District, Inc., the city's construction agency. An original contract between the city and Central District was voided by the supreme court of New Jersey on the grounds that exclusive use of the terminal was granted to the Central Railroad of New Jersey. Under the revised agreement, only the Central Railroad will have tracks in the port development, but the tracks must be available to all other railroads at rates to be determined by the Interstate Commerce Commission. The Pennsylvania Railroad representative stated that the revised contract was still not acceptable to that railroad and threatened to protest to Washington unless changes were made.

◆

117 Million in N. Y. Budget For Delaware Aqueduct

That over the next five years the city of New York expects to spend $117,315,000 for construction of the Delaware water supply project was revealed when Mayor La Guardia submitted his $278,000,000 capital outlay budget to the Board of Estimate.

The budget asks $117,315,000, which will be spent over a period of five years at the rate of about $25,000,000 per year; $20,000,000 was appropriated for the project in last year's budget. These figures cover construction of the first stage of the project, embracing an 85-mile pressure tunnel aqueduct from the Roundout Reservoir, construction of the Roundout and Neversink Reservoirs, and a short connecting tunnel. It is expected that work on the second stage will begin before the first stage is completed, the second stage including the East Branch Reservoir and a tunnel connecting it with the Roundout Reservoir. The total cost of the two stages will amount to about $272,587,000.

The largest of the other items in the budget provided $31,996,000 to be spent over a four-year period for extension of the city's independent subway system. This includes $10,000,000 for extension of the Fulton Street line in Brooklyn and an item of $10,900,000 for 250 new cars.

The Board of Education will require $31,430,000 over a two-year period for new schools, and the Department of Hospitals will expend $14,438,000 for hospitals and equipment over the next two years.

Floor Form Scaffold Crashes Safety Net On Golden Gate Bridge, Killing Ten Men

A movable scaffold suspended by metal hangers from the lower flanges of the transverse girders on the Golden Gate Bridge broke from its supports near the center of the 4,200-ft. span on Feb. 17, plunging working platform and crew into the safety net beneath. The weight and impact ripped the rope net from its fastenings, dropping twelve men 200 ft. to the water below; only two were rescued from the water alive. The net previously had saved eleven lives, keeping intact a remarkable safety record of no fatalities made on the foundations, towers, stiffening trusses and cables.

The scaffold which fell was about 20 ft. wide and 60 ft. long and was used for stripping forms from the underside of concrete floor slab which was being poured in three 20-ft. lanes; it was located under one of two outside lanes both of which had been completed almost all the way across the bridge. Of the four supports made up of steel hooks and aluminum casters, one is missing and a second is broken across the aluminum side piece as shown in the accompanying view. This break would have dropped one end of the scaffold and, as it swung downward, the 6-in. wheels used to advance the scaffold as work progressed would have rolled it toward the lowered end until the platform with the men on it slid off the supporting rails.

The supports were attached to the lower flange of transverse girders in the floor system which are spaced 25 ft. apart. Six supports were provided, but only four were used when the scaffold was being rolled ahead; the extra pair at that time were laid on the scaffold until the front end of the platform was in the advanced position under another transverse girder. The device for attaching the supports to the lower flange is a pair of hooks prevented from spreading by a bolt put on after the hooks are swung into position. The hooks are bolted to a pair of triangular-shaped plates, on the lower edges of which are bolted two pair of 6-in. wheels slightly separated so that the upper flange of the scaffold I-beam or rail can rest on their tops while the web of the beam passes between them. The platform rests on the lower flanges of the rails.

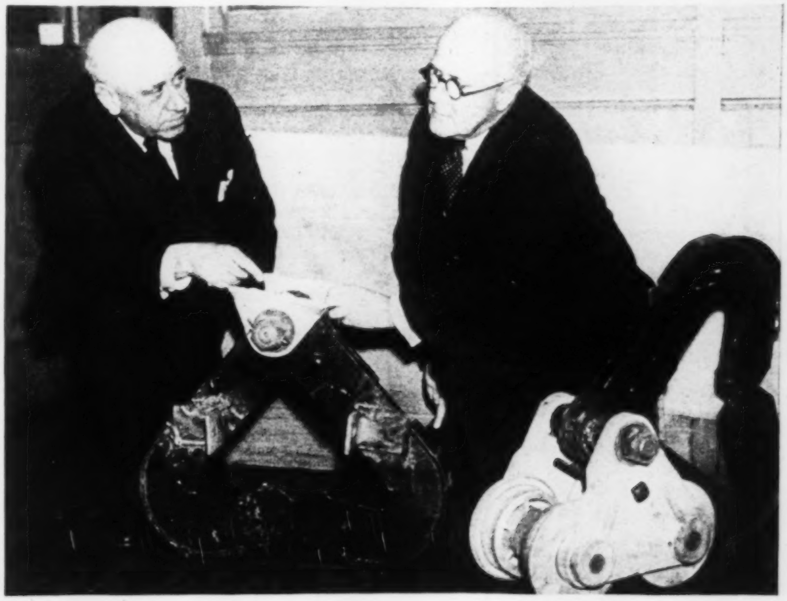
In the process of the hearings and investigations one of the points on which much stress has been placed is the question of whether the safety bolts were in place at the time of the accident. Testimony is not altogether consistent on this point. Another point is that after the rig was placed in service holes were drilled through the plates and a bolt put in to prevent the plates from separating. This bolt is parallel to the shafts of the wheels on which the platform I-beam moves. This bolt can be seen in the left pair of hooks shown in the picture below.

At the time of the accident workmen were stripping forms from the under side of the floor slab paving. Some jumped free of the moving platform into the net only to be carried down when the platform tore the net free. The 2,100 ft. of the net from the scene of the accident to the San Francisco tower was ripped from its fastenings by the crash. Some of the men literally rode the net down.

The paving contract on the Golden Gate Bridge is held by Barrett & Hilp and the Pacific Bridge Co.

SCAFFOLD SUPPORTS used on Golden Gate Bridge being inspected by members of the California Industrial Accident Commission. The break through the aluminum side plates is shown at the left. At the right the intact caster detail is shown; an I-beam hung on the wheels supported the movable platform.

Wide World Photo



Spillway Cuts Crest Of New Orleans Flood

Bonnet Carré Spillway, nearly full, cuts flood crest three feet—Flow in floodway reaches 200,000 sec.-ft.

By H. W. Richardson

Associate Editor, Engineering News-Record

*Baton Rouge, La.,
Feb. 22, 1937*

In the lower Mississippi valley the flood situation is well under control as the crest waters roll into the New Orleans district on their last lap to the sea. Just now the crest is at Natchez, where the gage reads 58, or 2.5 ft. higher than the previous record (1927).

Bonnet Carré spillway when inspected Sunday was working perfectly, and New Orleans lies unworried as the crest of the flood waters pass harmlessly into Lake Pontchartrain. On Sunday the spillway was discharging an even 200,000 sec.-ft., with river at El. 21.8 and tailwater 0.7 lower. Needles have been raised in all of the 176 bays that have their sill at El. 18, and in all but 59 of the 174 bays with sill at 16. The floodway flow is concentrated along the guide-levee borrowpits except through the highway bridge, where fill approaches narrow the opening to 5,000 ft. Outside of the borrowpits little of the floodway has been cleared, but there is considerable discharge through the uncleared areas. In its 6-mi. length the floodway widens from 7,000 ft. at the weir to 12,000 at the lake. At the Illinois Central R.R. bridge (near the lake) the water stands at El. 8 (at the north end) to El. 10.5 (at the south), the difference being due to the fact that the old highway acts as a submerged weir; with the lake at El. 2, the difference produces a rapid fall of the flood waters at the lake shore, causing some scour back toward the railroad bridge.

It is estimated that the stage at New Orleans has been lowered 1 ft. for every 60,000 sec.-ft. through the floodway. By this calculation the spillway on Sunday was lowering the city's stage 3.3 ft. (Carrollton gage then at 19 ft.). As the New Orleans levees are good only for 21 ft. it is evident that the spillway saved New Orleans from a critical situation, if not from submergence.

The spillway affects river stages as far as Angola, 172 river miles upstream from Bonnet Carré. Last Friday the main river below Angola was discharging 1,380,000 sec.-ft. The flow line of this discharge, compared with a flow of 100,000 sec.-ft. less in 1927, shows 0.4 ft. higher at Angola, 0.8 ft. lower at Baton Rouge, 1.9 ft. lower at Donaldsonville, and 2.4 ft. lower at Reserve, 12 miles above the spillway.

A trip through the upper end of the Atchafalaya Basin today showed everything under control, with preparation for trouble proceeding at rapid but orderly pace. Old River is carrying slightly over 400,000 sec.-ft. from the Mississippi into the Atchafalaya; the Red River discharge is very low. The Atchafalaya is carrying 15 per cent more water at bank-full stage than in 1932 because of recent channel improvement and dredging of the lower basin.

Some work is being done along the old fuseplug levee, from Morganza to Hamburg, on the Red River above Simmesport. The main preparatory work is building 4.4 mi. new levee from Morganza westward to the upper end of the eastern Atchafalaya floodway guide levee to protect valuable land immediately west of the Mississippi River in case of a break in the fuseplug section. This new levee is a low emergency section. Bids were opened three days after advertising, and the work will be completed this week by the Atlas Construction Co., using four 6-yd. walking draglines 3½ weeks after starting the construction work.

Other emergency work, some by contract, includes a low ring levee around Simmesport, closure of the upper end of the western Atchafalaya guide levee, and closure of bayous, drainage and other gaps in the Atchafalaya Basin levee system. The work is under the direction of William New, area engineer, under the general direction of the district engineer, Lt. Col. W. F. Tomkins.

STAGES AND DISCHARGES—1937 FLOOD

Location	Date	Gage Height	Discharges sec. ft.	Remarks
Mississippi River at				
Memphis, Tenn.	Feb. 9	48.65	1,920,000	**Peak**
Vicksburg, Miss.	Feb. 15	52.48	2,020,000	
	19	52.80	2,040,000	
	20	52.88	2,050,000	Highest reached to date
	22	53.0	2,050,000	
Atchafalaya River at				
Krotz Springs, La.	Feb. 15	36.3	395,000	
	19	36.9	412,000	
	20	37.0	412,000	
	23	37.4	432,000	Highest reached to date

* * *

Unified Transport Regulation Proposed for Canada

Unification of the regulation of all forms of transportation in Canada under a Board of Transportation is called for in a bill submitted to the Canadian Senate on Feb. 2. The bill would convert the present Board of Railway Commissioners (corresponding to the Interstate Commerce Commission in this country) into a Board of Transportation with wide powers over all forms of commercial transportation. It embodies a plan of coordinated regulation favored by C. D. Howe, Minister of Transport, the engineer member of the federal cabinet. For the first time, under the provisions of the bill, water and air transport would be required to file their rates for review of the board, as now is required of the railroads. At the discretion of the minister, the present broad powers now possessed by the Board of Railway Commissioners would be extended to shipping between Canadian ports, air transport, interprovincial highway transport and all traffic on Dominion highways.

Connecticut Civil Engineers Hold Annual Meeting

In a two-day session at New Haven on Feb. 16 and 17, the Connecticut Society of Civil Engineers discussed a wide range of subjects of current importance in the state, ranging from flood gaging and utility regulation to public-works construction. The occasion was the 53rd annual meeting since the Society was founded (1884).

Flood gaging in Connecticut

Burke L. Bigwood, district engineer of the U.S. Geological Survey at Hartford, in reporting on the gaging of Connecticut rivers in the great flood of March, 1936, stated that in this flood, which ended a severe drought period, 22 out of 26 gaging stations yielded complete flood hydrographs, while four stations were submerged. Current-meter gagings at peak stage and intermediate stages were made at every station so far as possible. A 20-day total rainfall of 22 in. was registered at Pinkham Notch, N. H., during the March rainfall that caused the flood. The peak flow at Hartford, with a drainage area of about 10,000 sq.mi., was 285,000 sec.-ft., or roughly 28 sec.-ft. per sq.mi. But for the fact that the number of stream-gaging stations had been greatly increased only a few years before the flood—there were only two gaging stations in Connecticut at the time of the 1927 flood against 31 stations now—the records of the 1936 flood would have been far less complete.

Regulation of transport

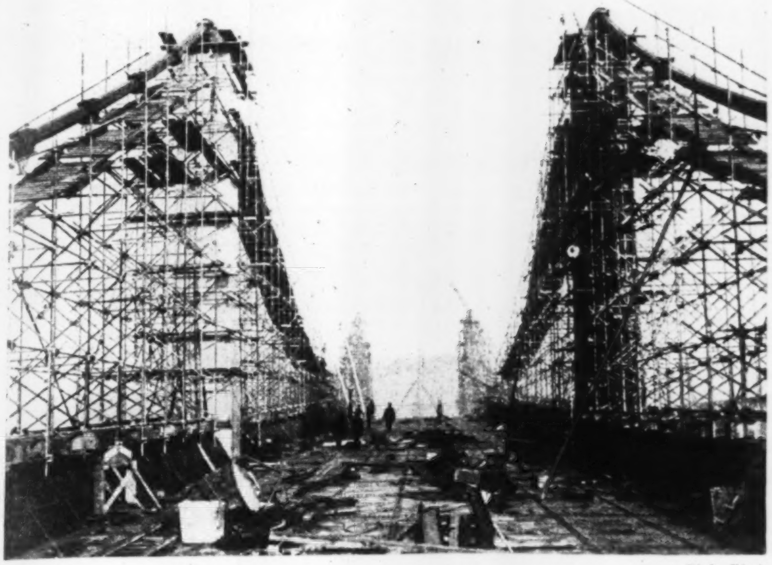
In an interesting sketch of more than a hundred years of transport regulation in Connecticut, J. P. Wadhams, transportation engineer of the Public Utilities Commission, traced out regulatory efforts from early attempts in the horseback and stagecoach days to the establishment of the Public Utilities Commission in 1911, and reviewed briefly the accomplishments of the commission, especially in safety. Development of the now widely standardized double-flashing signal for highway crossing protection is one of the commission's accomplishments. Livery car and truck regulation was begun in 1929 to 1935.

Early regulatory systems were mentioned by C. R. Harte in discussion. The first regulation of transportation was enacted about 1797, and when railroads were built there were individual railroad commissions for the several lines as well as a general railroad commissioner. Annual physical inspection of each property was required. The makeup of the regulatory commission (a lawyer, a civil engineer and a business man) specified by the early statutes is still maintained.

Middletown bridge foundation

Deep foundation work for the Middletown bridge was described by L. H. Beebe, project engineer of the state highway department. Some of the foundations were put down by the Montee rotating-caisson process and others by open cylinders. Several of the latter collapsed under unbalanced side pressure while being sunk, and had to be recovered by pneumatic caissons.

In discussing public utility regulation Dr. C. O. Ruggles of the Harvard School



Globe Photo

New Chelsea Bridge Takes Shape Over Thames in London

AT THE BEGINNING of the year, work on the Chelsea Suspension Bridge over the Thames in London had reached the stage of suspender installation. The bridge, which is replacing an old eyebar chain suspension bridge built in 1858 with cast iron towers, is of the self-anchored type, using box girder stiffening members, tubular steel towers, and open cables made up of thirty-seven 1-7/8 in. diameter wire ropes. The main span is 352 ft. long and the side spans 173 ft. A 40-ft. roadway is provided, and there are two 12-ft. cantilevered sidewalks.

The deck was assembled in four units (one for each side span and two for the center) and floating into position on temporary towers, placed so as not to interfere with navigation. The rocker towers were then erected and guyed, after which the cable ropes were fastened to the ends of the stiffening girders and raised to the tower saddle. Tubular steel braces assisted in this operation and in installing the cable bands and suspenders.

The bridge is being built by the London County Council to designs by Rendel, Palmer, Ampers and Tritton, Consulting Engineers.

---

of Business Administration expressed dissent from the view that utilities are best regulated by building competing plants, on the ground of the economic waste involved. He added, however, that effective yard-sticks of cost are urgently needed, saying that important litigation has given rise to a widespread conviction that regulation has broken down. Fair and equitable cost standards should be the yardstick, he said. In his opinion federal utility projects should be subjected to the same type of control as private utilities, best by federal regional commissions.

Other papers

The Milford activated sludge plant was described by V. B. Clarke, consulting engineer, water tower construction by J. W. Holden, engineer of the water bureau of New Britain, and a Hartford grade separation by H. E. Brink, of the New Haven R.R. Prof. Dana Young, Connecticut State College, Storrs, reviewed the use of models in structural design. A discussion of expansion and contraction treatment of pavements was presented by A. W. Bushell and J. H. Smith, of the state highway department.

Mr. Clarke estimated the cost of sewage treatment necessary for protection of the Milford beaches at $461,000. The paper of Messrs. Bushell and Smith outlined the difficulties of providing for expansion and contraction in concrete pavements, especially the problem of maintaining a seal to keep surface moisture from reaching the subgrade and reducing the support of the slab in the joint region. A self-expanding compression joint with a seal of latex and an accelerating chemical was characterized as the best approach to a solution yet devised.

Members honored

Prize awards for papers presented to the Society were conferred on Prof. Charles S. Farnham, Yale University, for a paper on structural surveying, and to Prof. Dana Young for his paper on models in structural design. Charles J. Bennett, former State Highway Commissioner, and J. W. Alsop, chairman of the Public Utilities Commission, were elected honorary members.

An interesting feature of the meeting was an illustrated lecture by E. E. Minor, general manager and engineer of the New Haven Water Co., on the forestry, storage and other phases of the extensive supply system serving New Haven and vicinity. The company has carried on thirty years of planned forestry, begun by A. B. Whitney, former consulting engineer of the company, with the cooperation of the Yale Forestry School. At present substantial timber yields are being obtained from these forests in the collection and storage areas of the water supply system.

A. W. Bushell, Hamden, was elected president, succeeding B. H. Palmer, Jr. E. T. Nettleton and Charles Rufus Harts, New Haven, were elected vice-presidents. H. Jackson Tippet, New Haven, is secretary-treasurer.

Tax Diversion Under Attack

Washington Correspondence

Diversion of gasoline tax revenues to other than highway purposes is under attack on a number of fronts now that the emergency which caused many states to use such receipts instead of other revenue during the depression is ending.

In Congress, both authors of the Hayden-Cartwright federal aid act have issued statements indicating that future federal aid may be sharply reduced or even eliminated for states which continue to divert their highway funds. Representative Cartwright has stated: "Congress cannot be expected to continue indefinitely attempts to help complete the highway systems of those states which pursue the indefensible practice of misappropriating their own gasoline and other motorists' special taxes to purposes not relating to highways. Congress has formally declared this practice unfair and unjust. It should now be made unprofitable as well."

An attempt to discourage diversion of gas tax and license fees was written into the federal-aid highway act of June 18, 1934. This act provided that a reduction of as much as one-third in the federal funds allotted to any state might be made in the event that it increases the amount of diversion above that which it was diverting at the date of passage of the act. Although this provision has never yet been invoked, it has had some effect in discouraging state legislatures from raids on road funds.

Actual imposition of a penalty is complicated by the indefiniteness of the law. Since diverted funds must actually have been spent before the Bureau of Public Roads can make a case, effective enforcement would require a continuous check on the receipt and expenditure of highway funds in each of the 48 states. The amount of the penalty is discretionary within the one-third limitation, and there is no guidance for its computation. Furthermore, it has never been made clear whether, if the state has long diverted a fixed percentage of its gas taxes and the total collections rise, the state is or is not guilty of increased diversion.

In the States, constitutional amendments to outlaw tax diversion have been proposed in Alabama, Massachusetts, and Pennsylvania, while statutes intended to accomplish the same purpose are pending in Indiana, New York, North Dakota, Utah, and several others. On the other hand, a few states are trying to perpetuate so-called temporary or emergency gasoline taxes or tax increases originally imposed on a short-term basis.

⁂

Civil Engineers Give Support to Registration Activities

At the meeting of the board of direction of the American Society of Civil Engineers recently a contribution of $1,000 was voted to the National Council of State Boards of Engineering Examiners. Funds were also allocated to the society's committee on registration, both actions being an expression of the society's desire to further engineering registration activities.

Cost of Bonneville Fishways Estimated at $6,500,000

Since original plans were drawn for fishways at Bonneville Dam on the Columbia River (the estimated cost then was $800,000) there has been almost continual discussion about what fishways are necessary for protecting salmon runs. Construction plans have been revised repeatedly in response to demands of fishery interests for more elaborate provisions. About a year ago (*ENR*, Feb. 13, 1936, p. 235) the estimated cost had been advanced to $3,500,000. Since then construction costs have increased, and construction of a fishway on the south side so complicated the contractor's work that an adjustment with him had to be made. Repeated revisions of cost estimates have been necessary; total requirement for fishways at Bonneville Dam now is estimated at $6,500,000.

Much publicity has attended recent requests from state fish commissions of Oregon and Washington that the downstream section of the cofferdam now in use be left as a temporary aid in getting fish over the spillway dam. Army engineers ruled this proposal impracticable and, with approval of the Federal Bureau of Fisheries, adopted plans for temporary fish ladders to handle the 1937 runs of salmon at three points, namely, bay No. 1 on the Washington side, bay No. 18 on the Bradford Island side and bay No. 10 in the center of the river. This central ladder will be constructed through the portion of the cofferdam parallel to the river flow which will be left in place temporarily for this purpose. Both the upper and the lower cross-river arms of the present cofferdam are to be removed on completion of the concrete work in the north half of the spillway dam, probably in March or April, before the 1937 spring freshet is due.

◆

A.W.W.A. Announces Awards For June Meeting

The board of directors of the American Water Works Association, at its annual meeting in New York Jan. 20, received and approved the reports of the various awards committees. Presentation of the following awards will be made at the annual convention in Buffalo, N. Y., on June 7-11.

The Diven Medal is awarded for 1937 to Abel Wolman for service to the association during fifteen years as editor of the Journal of the American Water Works Association, for leadership of the committee on water resources policy, and service as chairman of the President's water resources committee.

Four members were elevated to honorary membership in the association: Thomas Brooks, superintendent of the street main division of the Los Angeles department of water & power; William W. Brush, editor, Water Works Engineer, president of the association in 1929, treasurer since 1930, Diven medalist in 1932, and formerly chief engineer of the New York department of water supply, power, and electricity; Ross L. Dobbin, general manager of the utilities commission of Peterborough, Ontario, Diven medalist in 1930, and president of the association in 1932; and William M. Rapp, superintendent of construction and distribution of the water department of Atlanta, Ga.

The John M. Goodell prize for 1937 was awarded jointly to Harry Hayes, assistant engineer, bureau of water works and supply, Los Angeles, Calif., for his paper on "Laboratory Control of Protective Treatment for Steel Pipe Lines by the Bureau of Water Works and Supply, Los Angeles," and to Laurance E. Goit, chief draftsman, bureau of water works and supply, Los Angeles, Calif., for his paper on "Steel Pipe Cleaning and Coating of the Bureau of Water Works and Supply of Los Angeles."

◆

Construction Bids Called For Sardis Dam

Bids will be opened by the U. S. district engineer at Vicksburg, Miss., on March 9 for the construction of Sardis Dam on the Little Tallahatchie River near Sardis, Miss. The dam, a combination of hydraulic and rolled fill, will be the second largest earth fill in this country, and the third largest in the world, exceeded only by Fort Peck and Gatun Dams.

Included in the work now being advertised are 2,364,000 cu.yd. of excavation, 1,678,000 cu.yd. of rolled fill, and 12,545,000 cu.yd. of hydraulic fill. Diversion and control of the river during construction is also included. Spillway and outlet works will be built under another contract for which bids will be called later.

The main embankment, of which the top 10 ft. will be rolled fill, will be 96 ft. high and 8,700 ft. long. Earth dikes extend from each abutment for a total of 4,300 ft. more. The dam will be built in three sections, one on each side of the river and a center closure section, the same procedure as at Fort Peck Dam. Final diversion of the river will be through a tunnel.

The work must be completed within 1,200 calendar days; penalty for delay is $300 daily. Sardis Dam is part of the lower Mississippi River's flood control program.

◆

PWA Announces Rentals On Atlanta Housing

(*Continued from page 312*)

are covered with asphalt tile; steel casement windows are used throughout. screens are provided for all windows.

The PWA has issued a call for bids to be opened March 9 for construction of the superstructure on the revised plan for Andrew Jackson Court, the PWA $1,500,000 slum clearance and low rent housing project in Nashville, Tenn. The invitation marks the third time PWA has called for bids on this project. Bids for construction of the superstructures on the Nashville project were twice rejected as excessive by Administrator Ickes. Last November action was taken to revise the plans, modifying construction specifications and increasing the number of living units. The present plans call for the erection of 398 living units in one- and two-story group houses and two-story apartment flats. This increase of nearly 50 per cent over the originally planned 270 living units will add sufficiently to the rental income to offset the cost of this construction. The 50 structures in the project will be of brick. Foundations already completed will be utilized without alteration; the increased number of living units will be achieved by converting 31 one-story structures into two-family flats.

Administrator Ickes has ordered advertisement for bids for the building of two additional apartment buildings for Laurel Homes, PWA's $6,500,000 low-rent housing project now under construction in Cincinnati, Ohio. Bids will be opened March 24.

By adding the new buildings, 114 additional families will be able to occupy Laurel Homes, which will then have a total of 1,039 units, in contrast to the 925 previously planned. It will be the second largest PWA housing project. The largest project in the entire group is Williamsburg Houses in New York City which will house 1,614 families.

The new contract will also include the construction of two store buildings, which provides leasing space for some 18 stores to serve the big community.

Foundations for the 21 buildings included in the original contract were completed January 4 by the Corson Construction Company of Cincinnati.

◆

SOCIETY CALENDAR

AMERICAN RAILWAY ENGINEERING ASSOCIATION, annual meeting, Chicago, Ill., March 16–18.

NATIONAL RIVERS AND HARBORS CONGRESS, annual convention, Washington, D.C., Apr. 26-27.

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, mid-winter convention, Albany, N. Y., March 6.

NEW JERSEY SEWAGE WORKS ASSOCIATION, annual meeting, Trenton, N. J., March 11-12.

NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION, annual meeting, Atlantic City, N. J., March 17–19.

FLORIDA ENGINEERING SOCIETY, annual meeting, Tampa, Fla., March 18–20.

AMERICAN WATER WORKS ASSOCIATION, INDIANA SECTION, Indianapolis, Ind., March 25–26.

AMERICAN WATER WORKS ASSOCIATION, FLORIDA SECTION, Ocala, Fla., March 30–April 1.

AMERICAN WATER WORKS ASSOCIATION, KENTUCKY-TENNESSEE SECTION, and SOUTHEASTERN SECTION, joint meeting, Chattanooga, Tenn., April 5–7.

GREATER NEW YORK SAFETY COUNCIL, annual convention, New York City, April 13–14.

AMERICAN WATER WORKS ASSOCIATION, CANADIAN SECTION, Montreal, Canada, April 14–16.

AMERICAN WATER WORKS ASSOCIATION, MONTANA SECTION, Lewiston, Mont., April 19–23.

AMERICAN WATER WORKS ASSOCIATION, FOUR STATES SECTION and **PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION**, joint meeting, Philadelphia, Pa., April 22–23.

AMERICAN WATER WORKS ASSOCIATION, ILLINOIS SECTION, Springfield, Ill., April 29–30.

LICENSE EXAMINATIONS

IOWA, examinations for professional engineering on March 18–19 and examination for land surveying on March 20, Des Moines, Iowa.

Kansas City School Building Suffers Roof Collapse

A portion of the roof of the Benjamin Harrison School in Kansas City, Mo. collapsed on Sunday, Feb. 14, causing damage to rooms on the upper floor. Due to the circumstance that the accident occurred on Sunday and that consequently no one was in the building, no injuries resulted from the collapse.

The roof which fell covered the southwest corner of the newest section of the building. The building is a three story brick unit containing a gymnasium, an auditorium, and four classrooms. The classrooms are on the second and third floors. The reinforced concrete roof fell away from the west wall of the building. The damaged unit was built in 1925 as an addition to two other sections which were built in 1915 and 1919.

A preliminary investigation made by Superintendent of School Buildings Downes revealed, according to Superintendent of Schools Melcher, that the collapse was due to faulty construction. Superintendent Downes states that the architect's plans, drawn by Charles A. Smith, were adequate but that the contractor had made deviations from the plans which were not reported by the field inspector.

According to Mr. Downes, inspection of the building after the collapse indicated that the contractor had used poor cement, had not connected the concrete joists properly with headers in the walls and apparently had skimped on reinforcement. It appeared that insufficient bond was developed between the joists, the concrete headers, and the outside walls.

The building addition, which was built under a $117,000 contract, was accepted Dec. 18, 1926 with a 10-year period of bond recourse which expired a few months before the accident.

Power Sale Plan For Bonneville

(*Continued from page* 312)

[other] facilities . . . as the power development may fairly bear . . . The rate schedules may provide for uniform rates or rates uniform throughout prescribed transmission areas. . ."

The administrator is left free to choose between a policy blanketing transmission costs over the entire areas served and its converse, a sliding-scale system under which the cost of power would vary with the distance transmitted. Thus the committee leaves for future determination the most controversial feature.

The allocation of transmission costs is of great significance in the Bonneville case because the ability of the project to carry its charges is contingent upon its prompt expansion to full generating capacity in a market already highly developed. Proponents of the uniform rate claim that this can best be done by spreading the cost of a transmission system over the entire project, thus widening the area in which the new plant can compete with existing facilities and subsidizing distant consumers. Opposed to this is a faction convinced that the only hope of building up a large demand lies in the development of industries to be located close to the dam, to be attracted by ample power at the cost of generation only. More distant communities, they claim, are already well served at reasonable rates, and should receive Bonneville power only if they are willing to pay the costs of generation and transmission to the area of use.

Morris Llewellyn Cooke Resigns Government Post

Morris Llewellyn Cooke, Rural Electrification Administrator and a member of several important federal agencies, on Feb. 6 resigned his position as Administrator of the REA, asking the President to relieve him on Feb. 15. Mr. Cooke gave as his reason his desire to travel abroad for a rest.

President Roosevelt has nominated John M. Carmody, who has been acting head of the Rural Electrification Administration, to be Administrator of the REA.

In addition to his work as Administrator of the REA, Mr. Cooke has been active in the work of the National Resources Committee, having headed the special Mississippi Valley Committee and the Great Plains Drought Committee. He also served on the Power Policy Committee appointed by the President in 1936 and is a member of the special power policy committee named by President Roosevelt a few weeks ago.

Mr. Cooke has been actively associated with power matters in which the President is interested since the President, when Governor of New York, appointed him a member of the New York State Power Authority, a position that he resigned when the President called him to Washington.

Manhattan-Richmond Tunnel Urged in New York City

Mayor La Guardia of New York has requested the New York City Tunnel Authority to study a project for a vehicle tunnel to link Staten Island with the New Jersey highways and the arterial system of Brooklyn, Manhattan and Long Island.

In a letter to the chairman of the authority, the mayor asked for a report as early as possible so that he could consider possible means of financing. He suggested that meanwhile the authority prepare legislation to give it jurisdiction over the new project as well as over the East River tunnel and the Battery-Brooklyn tunnel already under its jurisdiction.

State Permit Is Granted For Chicago Filter Plant

Another step toward construction of the $17,000,000 Chicago south side filtration plant was taken Feb. 12 when the Illinois Department of Public Works and Buildings issued a state permit for the plant construction. Granting of the permit, for which application was made last August, followed holding of two public hearings.

Only two steps remain before work on the plant can proceed. A War Department permit must be obtained, but assurances have been given by the Department that the permit would be issued when the state permit was available. Then, before PWA money can be made available, assurances must be given to PWA that the city can raise its share, $11,500,000, of the expense. A PWA grant of $9,500,000 is contemplated.

Of the funds thus made available, $21,000,000, it is planned to use $17,000,000 for the filter plant itself and $4,000,000 for installation of meters and repairing of meters.

Norman Redwood Murdered In Labor Dispute

The shooting Feb. 18 of Norman Redwood, formerly general superintendent of construction on the Holland Tunnel for the Mason & Hanger Co. and recently business manager of the Compressed Air, Tunnel, and Subway Workers Local 102 of the International Hod Carriers Building and Common Laborers Union, at his home in Teaneck, N. J., is attributed by police to a three-sided labor dispute.

The dispute involves a jurisdictional struggle between Local 102 and the International Operating Engineers Union arising out of a strike by Local 102 against the Rosoff Tunnel Corp., contractors on the Wards Island sewer tunnel in New York City.

Mr. Rosoff, head of the Tunnel Corporation, and John Fay, an official of the Operating Engineers Union, have been taken into custody by the police as material witnesses.

Personals

L. E. Greathouse, assistant WPA administrator in St. Louis, Mo., and formerly connected with the Missouri highway department, has been appointed acting administrator for St. Louis to fill the vacancy caused by the resignation of **Joseph A. Amend**.

Norman D. Ackley, assistant resident WPA engineer for Green County, Ohio, has resigned that position to take up work with the General Electric Company in the steel mill industrial control section.

Herman G. Protze has been appointed engineer in charge of laboratory work for the Thompson & Lichtner Company, engineers, of Boston, Mass. Mr. Protze, a graduate of the Massachusetts Institute of Technology, has been an instructor there in the concrete and structural materials testing laboratories.

R. B. Howland has been elected vice-president and a director of United Engineers & Constructors, Inc. Mr. Howland, a graduate of Drury College in 1906 and Purdue University in 1910, was employed after his graduation by the Stone & Webster organization on hydro-electric construction work. In 1919, Mr. Howland became associated with Dwight P. Robinson & Company in New York City, and when, in 1929, that organization merged with three other engineering organizations to form United Engineers & Constructors, Mr. Howland became assistant to the president, holding that position up to the present time.

J. R. FAIRMAN has been appointed assistant vice president of the Pennsylvania-Dixie Cement Corporation of New York City. Mr. Fairman, a civil engineering graduate in 1909 from the University of Missouri, has been connected since 1920 with the Portland Cement Association, most recently as regional manager in charge of the eastern offices at New York City.

◆

Obituary

FRANK C. MANLEY, a civil engineer in the New York office of the American Bridge Co. since 1904, died in Roselle, N. J. on Feb. 17, aged 62.

FRANK J. SCHNAUBER, former city engineer of Syracuse, N. Y., died in that city on Feb. 16 at the age of 71. Mr. Schnauber was a graduate of the College of Applied Science of Syracuse University.

DONALD B. RUSH, president of the Rush-Roberts Engineering Co., Chicago, died there on Feb. 16 at the age of 50. Before the formation last year of the Rush-Roberts Company, Mr. Rush had been associated for many years with Robert W. Hunt & Co. and earlier had been employed by the engineering department of the Chicago & Alton Railroad and by Horace G. Burt, civil engineer; W. F. M. Goss, railway engineer; the late John F. Wallace, and Bion J. Arnold. He was a graduate in 1910 of Rose Polytechnic Institute.

JOHN NOLEN, consulting city planner and recently consultant to the housing division of the PWA, died on Feb. 18 in Cambridge, Mass. at the age of 67. Mr. Nolen had held the degrees of Ph. B of the University of Pennsylvania, 1893, and M.A. from Harvard, 1905, and had also studied in Germany. He began his architectural practice in Cambridge, Mass. in 1905 and laid out plans for numerous colleges, including Wellesley, Smith and Bates, and park systems for Madison, Wis., Chattanooga, Tenn., LaCrosse, Wis., New London, Conn., and Sacramento, Calif. Mr. Nolen had drawn up plans for the improvement of many cities throughout the country, and did the entire regional planning for Wyomissing, Pa. and San Diego, Calif. He had served as chief of the bureau of housing and town planning of the Army Educational Commission and as a member of the advisory housing committee of the Emergency Fleet Corporation and had also served as town planner for the U. S. Shipping Board and the U. S. Housing Corporation. The author of numerous books on city planning, Mr. Nolen was a past president of the National Conference on City Planning and the American City Planning Institute.

◆

LARGER AWARDS FOR THE WEEK

Two piercing mill units, Youngstown Sheet and Tube Company, Campbell, O.	$1,000,000
Completing Hampshire House, apartment hotel, New York, N. Y.	1,000,000
Senior high school, Norristown, Pa.	800,000
Widening and paving various streets, Chicago, Ill.	855,000
Electrification of main line system from Philadelphia to Harrisburg; also freight and passenger yards, Pennsylvania Railroad	50,000,000

INDEX NUMBER

ENR Cost	1913 =100	1926 =100	ENR Volume	1913 =100	1926 =100
*Feb., 1937	223.45	107.41	*Jan., 1937	167	73
Jan., 1937	223.45	107.41	Dec., 1936	206	90
Feb., 1936	201.20	96.71	Jan., 1936	248	109
1936 (Av.)	**206.46**	**99.24**	**1936 (Av.)**	185	81
1935 (Av.)	**195.22**	**93.84**	**1935 (Av.)**	135	58
1934 (Av.)	**198.10**	**95.23**	**1934 (Av.)**	114	50

* Correction due to correction in lumber price

CONTRACTS
(Thousands of Dollars)

	Weekly Average Feb. 1936	Weekly Average Prev. 4 Weeks	Week Feb. 25 1937
Fed. Government	$2,468	$3,469	$1,592
State and Municipal	28,087	22,256	10,652
Total public	$30,555	$25,725	$12,244
Total private	10,570	14,730	59,934
Week's total	**$41,124**	**$40,455**	**$72,178**

Cumulative to date:
1936 (9 weeks)....................$453,046,000
1937 (8 weeks)....................$362,274,000

Note: *Engineering News-Record* reports waterworks and earthwork, reclamation or waterways projects of $15,000 and over in size; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000 and over. The figures above represent the volume of contracts and large force account projects throughout the U. S. that are of these minimum sizes or over.

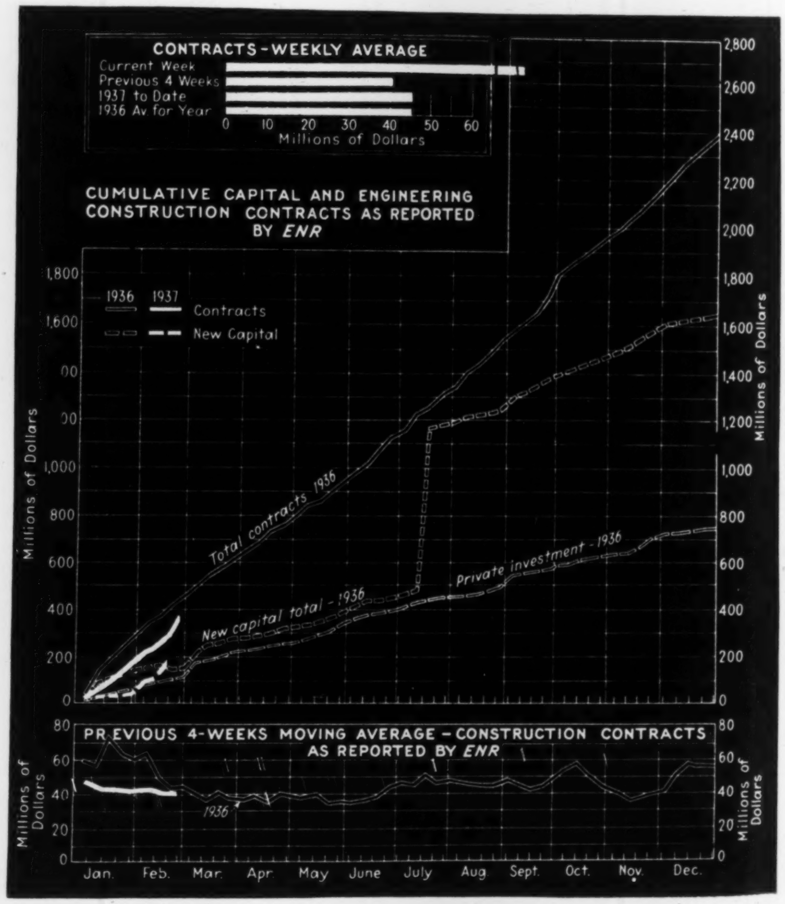
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1937	Week Feb. 25	Cumulative
Private investment	**$16,643**	**$187,629**
State and municipal bonds	6,643	122,626
Corporate securities	10,000	65,003
Federal financing	$—484	$—4,175
PWA non-federal Projects	......	......
Total non-federal	**$16,159**	**$183,454**
Federal projects	......	......
Total	**$16,159**	**$183,454**

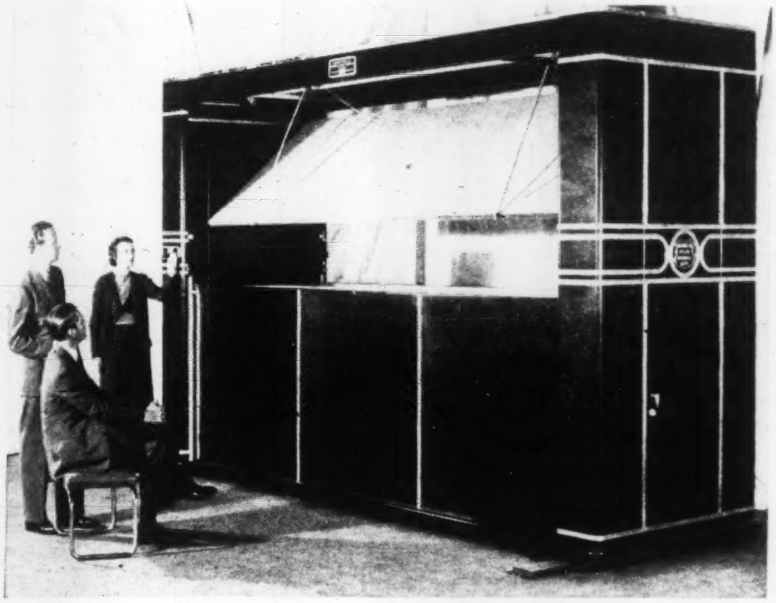
Cumulative to date:
1936 (9 weeks)....................$176,209,000
1937 (8 weeks)....................$183,454,000

Note: These figures include private bonds and stocks sold for new construction purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities. RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.

† Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.



Construction Equipment and Materials



Electrical Map Handling

A novel solution to the problem of handling and preserving large maps has been developed by the McCauley Map Case Co. of Detroit. In the McCauley system, the maps, in sections 4 ft. high and in widths running up to 16 ft. or more, are mounted on plywood board, one map on each side of the board. The sections are stored in a fireproof metal case and are handled by a small electric traveling crane.

Considerable flexibility in handling the map sections is provided, it is said. The crane will place and remove maps in any compartment of the case or turn them over. The map sections can be mounted vertically on either side of the machine, and provision is made for mounting two sections together, giving a map 8 ft. high; dowel pins in the map-sections are said to give correct alignment when this is done. The sections can also be mounted in drafting board position to be worked on.

The electric crane is controlled by a panel containing two switches, one regulating the up and down movement, the other the forward and backward movement. A panel is provided on each side of the map case.

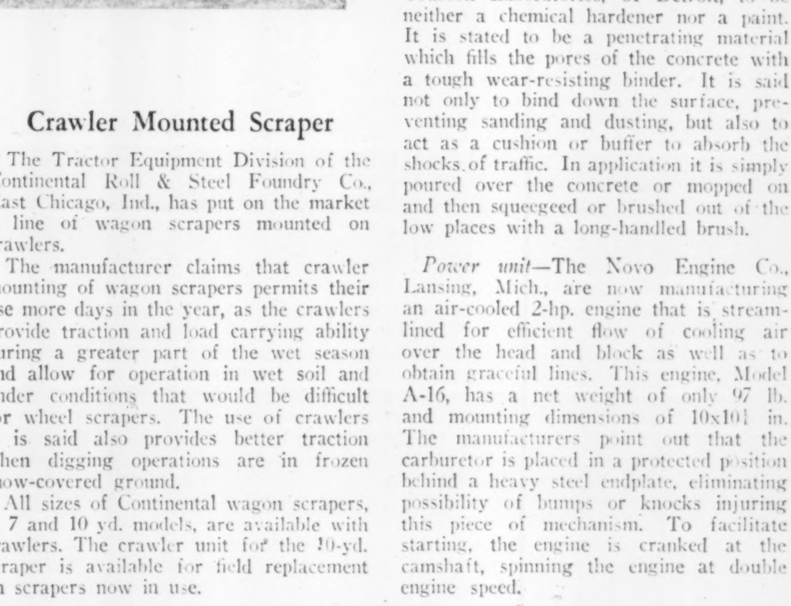
An interesting minor feature is a special hook, by which the map sections are attached to the crane, so designed that once it has been attached it is impossible, the manufacturer states, to release the hook without manual manipulation. This feature, in combination with a set of automatic stop switches to prevent overrun of the crane, is said to make it possible for any unskilled person to operate the map case without fear of injury.

Crawler Mounted Scraper

The Tractor Equipment Division of the Continental Roll & Steel Foundry Co., East Chicago, Ind., has put on the market a line of wagon scrapers mounted on crawlers.

The manufacturer claims that crawler mounting of wagon scrapers permits their use more days in the year, as the crawlers provide traction and load carrying ability during a greater part of the wet season and allow for operation in wet soil and under conditions that would be difficult for wheel scrapers. The use of crawlers it is said also provides better traction when digging operations are in frozen snow-covered ground.

All sizes of Continental wagon scrapers, 5, 7 and 10 yd. models, are available with crawlers. The crawler unit for the 10-yd. scraper is available for field replacement on scrapers now in use.



Map Mounting

Parafilm is a waxy substance manufactured in thin sheets by the Menasha Products Co., of Menasha, Wis., used for mounting maps or drawings on cloth, without the use of paste. With this material it is only necessary to place a sheet of Parafilm between the drawing and the cloth backing and iron with a hot iron. This is said to produce a smooth finish automatically. The map can be removed from its backing by going over the mounted map with a hot iron.

Parafilm is furnished in 25 and 150 ft. rolls, 20 in. wide.

◆

New Equipment in Brief

Flare—Highway flare torch No. 87, recently added to the line of the R. E. Dietz Co. of New York City, is of the self-righting spherical type with a weighted bottom and is said to have a burning capacity of 24 hours. It burns kerosene or light fuel oil with a ⅞ in. round wick in a new wind-proof burner with a thick rain-shield. The torch is finished in red enamel.

Floor hardener—Granitex, a new floor hardener and dustproofer for concrete floors, is said by its manufacturer, The Truscon Laboratories, of Detroit, to be neither a chemical hardener nor a paint. It is stated to be a penetrating material which fills the pores of the concrete with a tough wear-resisting binder. It is said not only to bind down the surface, preventing sanding and dusting, but also to act as a cushion or buffer to absorb the shocks of traffic. In application it is simply poured over the concrete or mopped on and then squeegeed or brushed out of the low places with a long-handled brush.

Power unit—The Novo Engine Co., Lansing, Mich., are now manufacturing an air-cooled 2-hp. engine that is streamlined for efficient flow of cooling air over the head and block as well as to obtain graceful lines. This engine, Model A-16, has a net weight of only 97 lb. and mounting dimensions of 10x10¼ in. The manufacturers point out that the carburetor is placed in a protected position behind a heavy steel endplate, eliminating possibility of bumps or knocks injuring this piece of mechanism. To facilitate starting, the engine is cranked at the camshaft, spinning the engine at double engine speed.

New Form Coatings for Special Concrete Finishes

To extend the scope of the familiar "Con-Tex" form coating for producing bonding and decorative exposed-aggregate surfaces on concrete, the Con-Tex Corp., Newark, N. J., has originated two new types of liquid form coatings that produce new surface effects and in addition announces a new coating for form-ties to render their removal easy after concrete has hardened. Of the form coatings, one is called "Light Fancy Con-Tex" and operates on a modified "Con-Tex" principle. The other, called "Kaston", operates on a different principle requiring no brushing-off of surfaces. The tie-coating material is called "Tyloose".

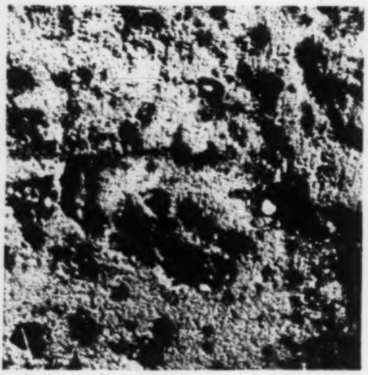
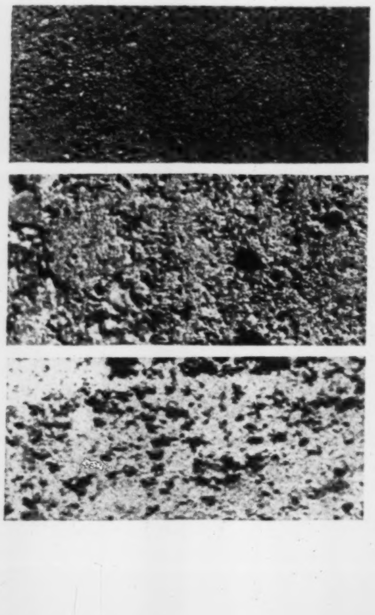


FIG. 1—PITTED SURFACE produced by Kaston form coating for ceiling bond.

"Light Fancy Con-Tex" is designed to produce distinctive acid-wash effects on either mortar or small-aggregate concretes. An exceedingly light "cut" is produced which suits its use to pre-cast units as well as to mass work.

FIG. 2—ORNAMENTAL SURFACES produced by Kaston coating. Top to bottom, wash, coral, and travertine.



"Kaston" is designed particularly for producing on horizontal surfaces, such as beam soffits and the underside of slabs, a bonding surface distinguished by a very large number of pittings, each about ⅛ in. deep and from ¼ to ¾ in. in diameter. Any final surfacing material, such as plaster, subsequently applied to this pitted face is stated to bond thereto with a strength of at least 20 lb. per sq. in. Applied to vertical forms, the coating produces a variety of patterns, according to the brushwork used in coating the forms. For instance, a straight stroking-out produces travertine-like effects. A heavy stippling produces a coral-like effect and so on in wide variety. As "Kaston", when applied, has a granular appearance on the forms, patterning is easily done.

The third new product is "Tyloose" a coating for form-bolts and form-ties to render easy their removal or break-off after concrete has hardened. It is applied either by brushing or dipping. It is stated that it renders easy the removal of bolts up to 24 in. in length and makes possible the forceful removal of even greater lengths.

A circular describing these new products and giving illustrations of their application is now being prepared by the Con-Tex Corp. and will soon be ready.

◆

Accurate Control Claimed For New Excavator

The Keystone Driller Co. of Beaver Falls, Pa., states that the outstanding feature of its new Model 18-A one-yard excavator is an accuracy of control which is obtained by the use of planetary drive and oversized clutches, combined with a smooth control lever system.

The machine is said to be built for a wide variety of digging, having one boom that is used in both trench hoe and skimmer service and to which a short extension may be attached for short-boom crane service. The machine is also available with a boom for dragline, clamshell, and crane.

Model 18-A is powered by Buda engines, either gasoline or diesel; or, if desired, it can be obtained with any standard make electric motor.

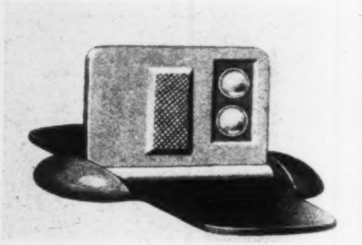
◆

Rubberizing Compound Needs No Primer

A compound by which a rubber coating can be applied to metal or other surfaces, for protection against corrosion, without the use of a primer has been developed by the Self-Vulcanizing Rubber Co., Chicago, Ill. The new product, Self-Vulc Insulator, is a rubber compound which incorporates the properties of a primer in a self-curing, cold-curing rubber, which can be applied by unskilled labor by dipping, spraying or hand brushing.

It is stated that the new product will provide a sound bond in one application, but that repeat coats to any desired thickness may be added. A vulcanizing period of one hour is said to be all that is required.

The insulator, the manufacturer states, resists corrosion caused by alkalis, salt solutions, or mild acids.



Centerline Marker

A centerline marker for highways that is intended to combine high visibility under all driving conditions with the provision of a maximum psychological barrier to crossing of the centerline has been developed by the National Traffic Appliance Co., of Cleveland, Ohio.

The device, the Life-Line marker, consists of a flat rubber blade, 4 in. high projecting vertically from a steel casting base imbedded in the pavement. The vertical blade or signal is hinged at the base, so that when run over it closes down into the base. An oil tempered spring brings the blade up again after it has been run over.

The blades are highway standard yellow and are said to be highly visible in daylight against any type of pavement. For visibility at night two reflectors are placed in each blade of the markers.

The Life-Line marker is manufactured in two styles. Type CRR has a flat rubber blade 2¼ in. wide by 4 in. high, while CRA has a bronze blade 4 in. wide and 3¾ in. high. Both types are made so that any part can be replaced individually. No painting is required as both the rubber and bronze markers will stay yellow indefinitely, it is said.

◆

Prize Competition Announced

The recently established Lincoln Arc Welding Foundation has announced that it will distribute 446 prizes, amounting to $200,000, for papers dealing with the subject of arc welding as a primary process of manufacture, fabrication, or construction in eleven major divisions of the industry. The principal prize winner will receive $13,700, and other prizes range from $7,500 to $100. Five prizes ranging from $700 to $150 are awarded in subclassifications established within each major industry; and four prizes ranging from $3,000 to $800 will be awarded in each industrial group. Finally, four grand prizes covering all entrants will be awarded, ranging from $10,000 to $2,500.

The structural field is divided into four sub-classifications: buildings, bridges, houses and miscellaneous.

It is necessary that the papers submitted describe either the redesign of an existing machine, structure, building, etc., so that arc welding may be applied to its manufacture, or that they present a design of a machine, structure or building not previously made; a description of the design must demonstrate how a useful result, which was impractical with other methods of construction or could better be done by arc welding, has been obtained in the design submitted.